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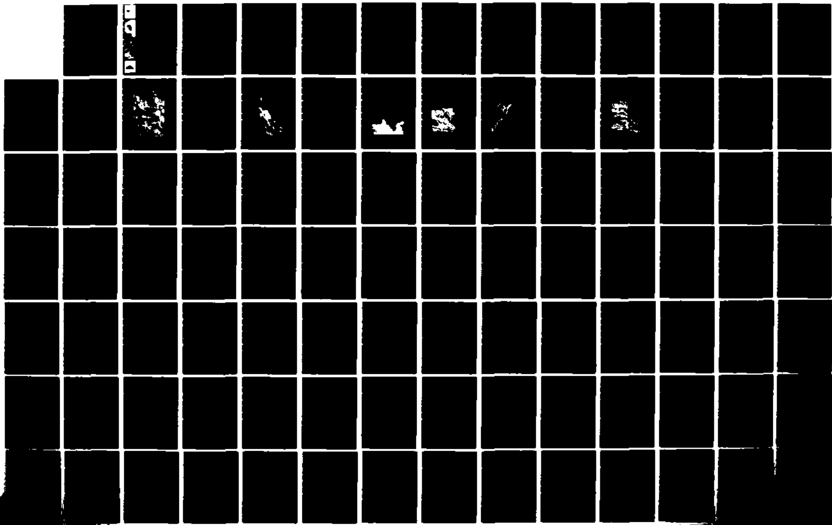

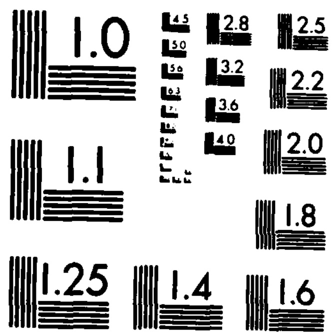

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GEOTECHNICAL
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TECHNICAL REPORT GL-84-8

(2)

GEOLOGICAL-SEISMOLOGICAL EVALUATION OF EARTHQUAKE HAZARDS AT WEST THOMPSON DAMSITE, CONNECTICUT

by

Ellis L. Krinitzsky

Geotechnical Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631
Vicksburg, Mississippi 39180

US ARMY ENGINEER WATERWAYS EXPERIMENT STATION

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A seismic zoning was developed for southeastern New England based on geologic structure and historic seismicity. Floating earthquakes were assigned for these zones and attenuated to the site. The site was found to be susceptible to a local earthquake (acceleration 0.16 g, velocity 13 cm/sec, and duration $\geq$ 0.05 g of 4 sec) and a Cape Ann earthquake (acceleration 0.13 g, velocity 13 cm/sec, and duration $\geq$ 0.05 g of 4 sec). Accelerograms and response spectra appropriate to these values were selected.

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PREFACE

The U. S. Army Engineer Waterways Experiment Station (WES) was authorized to conduct this study by the U. S. Army Engineer Division, New England, on 8 June 1982 by appropriation order FY 82-IAO No. 82-C-0031.

The study was conducted and the report written by Dr. E. L. Krinitzsky, Engineering Geology and Rock Mechanics Division (EGRMD), Geotechnical Laboratory (GL). A field reconnaissance was made with Mr. Edwin A. Blackey, Jr., then of the New England Division, Corps of Engineers. Dr. Patrick J. Barosh of Weston Observatory in Boston provided information from the New England Seismic Array and from his own studies. He later reviewed the seismic zonation developed in this report. Mr. Frank K. Chang, Earthquake Engineering and Geophysics Division, GL, selected the earthquake accelerograms to accompany the recommended peak motions. Mr. Dale Barefoot, EGRMD, assisted in compiling the data. The project was under the general direction of Dr. Don C. Banks, Chief, EGRMD, and Dr. W. F. Marcuson III, Chief, GL.

COL Tilford C. Creel, CE, was Commander and Director of the WES during the preparation of this report. Mr. Fred R. Brown was Technical Director.

CONTENTS

CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
cubic yards	0.7645549	cubic metres
feet	0.3048	metres
inches	25.4	millimetres
miles (U. S. statute)	1.609347	kilometres

GEOLOGICAL-SEISMOLOGICAL EVALUATION OF EARTHQUAKE HAZARDS AT WEST THOMPSON DAMSITE, CONNECTICUT

PART I: INTRODUCTION

Background

1. This study was made in order to define the maximum potential for earthquakes at the West Thompson damsite, on the Quinebaug River in the northeast corner of Connecticut, and to provide appropriate ground motions for earthquake shaking at the site. These motions are for use in the design analysis of the present earth dam and for appurtenant structures.

2. West Thompson dam is an earthfill structure with a maximum height of 69.5 ft* and a length of 2550 ft.

Regional Geology

3. New England has what is probably the most complicated geologic history in all of North America. Orogenic movements were almost steadily active for over a billion years. In the later stages of the orogenies, Paleozoic mountain building occurred at about 100-million-year (my) intervals from the Taconic, 440 my before the present, to the Palisade-White Mountain igneous intrusions from 200 to 16 my before the present. Only since then has there been a comparative stability.

4. These orogenies produced enormously complicated intrusive igneous rocks, extruded volcanics, metamorphosed rocks of all types, and eroded remnants of deformed and altered sedimentary deposits. In addition, all of these rocks were cut and displaced by major faults. These faults, however, have been largely inactive during the period of quiescence which extends into the present.

5. In the Quaternary, from the present to about 2 or 3 my ago, the region was at various times covered with ice sheets. There are effects today

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* A table of factors for converting U. S. customary units of measurement to metric (SI) units is presented on page 3.

of relaxation resulting from the removal of the last glaciers, which began to recede about 10,000 years ago.

6. Today there is sinking at a slow rate, several millimetres per year, along the New England coast in contrast to the geological rebound with the end of glaciation. The interior is mostly stable, but some interior areas are rising at a slow rate.

Local Geology

7. The West Thompson damsite is situated on the Quinebaug River in the northeast corner of Connecticut, as shown on the geologic map in Figure 1.

8. The dam was built on unconsolidated valley fill which is partly alluvial in origin, partly glacial, and possibly partly lacustrine. The uppermost 10 ft consists of sands and silts that contain some gravel and some pockets of organic matter. Parts of the valley surface are dotted with large rock blocks and boulders with dimensions up to 40 cu yd. The upper subsurface layer may contain erratics of this sort. Beneath are stratified sands and silts which are in turn underlain by glacial till. The valley fill is 32 to 66 ft thick under the dam and averages about 50 ft thick. Valley fill under the right abutment varies in thickness from 28 ft near the valley to 11 ft. The left abutment is on 38 to 13 ft.

9. The damsite (Figure 1) is underlain by the Mamocoke gneiss according to Foye (1949). Foundation investigations (West Thompson Design Memorandum No. 6, 1963) indicate that bedrock is a granite gneiss with micaceous schist. The rock is massive with failure planes along steeply dipping joint sets. The rock is weathered to about 5 or 10 ft on the right abutment. On the left abutment, weathering is deeper, up to 20 ft or more.

10. No evidences of faulting at or near the damsite were observed during the exploratory investigations.

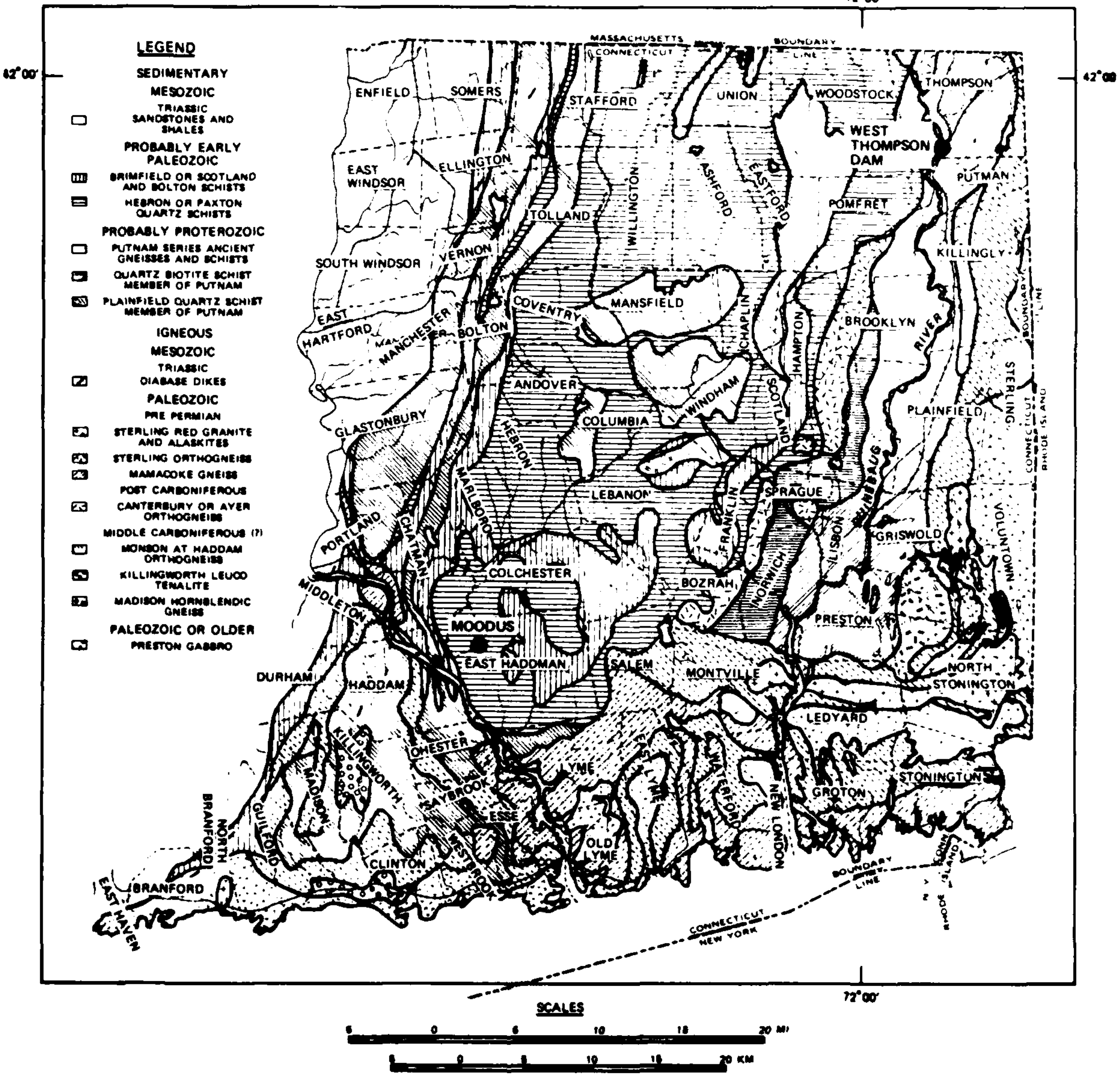

Figure 1. Surface geology in eastern Connecticut (from Foye, 1949)

PART II: SEISMIC HISTORY

Distribution of Earthquakes

11. The distribution of historic earthquakes in southeastern New England from 1568 to 1977 is shown in Figure 2. These events are from the earthquake catalogue assembled by Chiburis (1981), with supplements by Stover and von Hake (1980, 1981, and 1982). The earthquakes shown in Figure 2 are tabulated in Appendix A of this report.

12. Earthquake severity, measured by the way an earthquake is felt and the amount of damage that is done, is interpreted in the United States according to the Modified Mercalli (MM) Intensity Scale, which is shown in abbreviated form in Figure 3. It may be noted in Figure 3 that MM VIII is the threshold where slight damage begins to appear in well engineered structures. MM VII represents negligible damage where design and construction has been proper.

13. Where there have been multiple interpretations of intensity for a historic earthquake, the alternative values are shown by Chiburis; however, he has applied a uniform appraisal to the historic data, and he gives his choice for the intensity level.

14. The most significant variances between Chiburis and others for intensity levels a' rce (I_o) of the earthquakes considered in this report are as follows:

Earthquake	Location	MM I_o by Others (see Chiburis, 1981)	MM I_o by Chiburis (1981)
1727 Nov 17	Cape Ann, Mass.	IX	VIII
1755 Nov 18	Cape Ann, Mass.	IX	VIII
1791 May 16	Moodus-E. Haddam, Conn.	VIII	VI

15. There is a tendency in older accounts to accord a greater severity to earthquakes than they may reasonably require, especially if they are experienced infrequently. Additionally, there are always unknown factors, particularly the presence or absence of unfavorable ground conditions. MM VIII or IX may result locally from poor ground and occur adjacent to MM VII on better ground. MM VII can reasonably account for numerous snapped chimneys, but

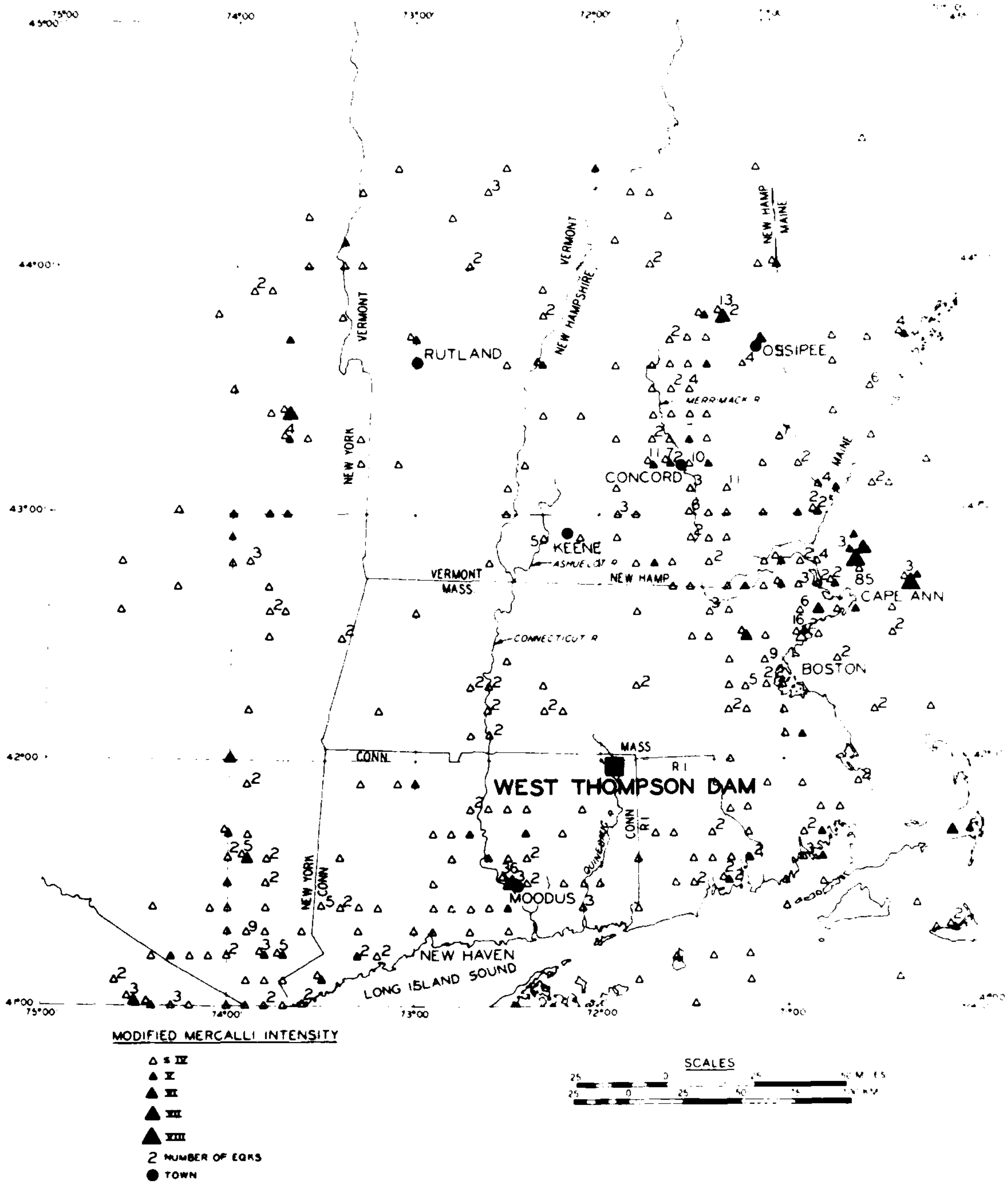

Figure 2. Historic earthquakes in southeastern New England from 1568 to 1977 (from Chiburis, 1981)

MODIFIED MERCALLI INTENSITY SCALE OF 1931

(Abridged)

I. Not felt except by a very few under especially favorable circumstances.

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated.

IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls made cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.

V. Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles and other tall objects sometimes noticed. Pendulum clocks may stop.

VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.

VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures, some chimneys broken. Noticed by persons driving motor cars.

VIII. Damage slight in specially designed structures, considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturbed persons driving motor cars.

IX. Damage considerable in specially designed structures; well designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.

XI. Few, if any (masonry), structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

Figure 3. Modified Mercalli Intensity Scale of 1931 (abridged) (from Barosh, 1969)

MM VIII should cause twisting of chimneys. However, no matter what criteria are used, some speculations concerning conditions in the eighteenth century, or the meaning of descriptions in contemporary accounts, may never be resolved.

16. Figure 2 shows that for 400 years of record there are only two MM VIII earthquakes, both offshore at Cape Ann. MM VII is represented by one event at Cape Ann, one in New York, and two in New Hampshire at Ossipee. All remaining earthquakes are MM VI or less. The overwhelming majority are MM IV or less.

17. To summarize Figure 2, most of the seismic activity follows a band about 50 miles wide and parallel to the coast of southeastern New England. Within this band, the seismic events tend to occur in the form of several general concentrations. One concentration extends from Boston-Cape Ann up the valley of the Merrimack River. A second is in the region around Moodus. Another is in Rhode Island. Included in the coastal band are some very small areas in which earthquakes are concentrated at Moodus, Cape Ann, and Ossipee, and where the largest of the earthquakes have occurred. These areas are designated as seismic hot spots.

18. At Concord there have been frequent, but very small earthquakes, MM V and less. Because of the absence of any events greater than MM V, which is characteristic of most of the coastal belt, Concord is not distinguished from the rest of the coastal belt.

19. On the basis of the distribution of historic earthquakes, a tentative zoning for southeastern New England was made to test for corroborative evidence in the geophysical data. The boundaries for these zones and for the seismic hot spots will appear in the figures discussed in the next section on the relation of seismicity to geology.

20. An earthquake zone as used in this report is an inclusive area over which a given maximum earthquake can be assigned for any point in the zone. This maximum earthquake, or maximum credible earthquake, is the largest that can reasonably be expected. The earthquake must be moved throughout the zone because causative faults in this part of New England have never been identified.

21. An axiom in earthquake theory is that earthquakes are caused by movement or slip along faul . Strain energy builds up from slowly operating processes of regional n until a sudden adjustment occurs in the form of movement along a . The slip is sudden and produces an elastic rebound.

The resulting vibration is felt as an earthquake. Though earthquakes have been numerous, there is no evidence of fault movement at the surface in the study area.

22. To achieve a powerful earthquake, like the San Francisco earthquake of 1906, movement must occur along a large segment of fault, from tens kilometers to a hundred or more. The depth of fault movement also must be appreciable, 20 or so km, in order to allow a large enough stress drop and energy release needed to produce severe earthquake shaking. In New England, where the surface traces of the faults show no evidence of recent movement and the focal depths of recorded earthquakes are relatively shallow (Table 1), the potential for very great earthquakes does not appear evident.

Relation of Seismicity to Geology

23. The map in Figure 4 presents the patterns of magnetic anomalies (Harwood and Zietz, 1977). The source areas for the severest earthquakes in this region are Moodus and Cape Ann, based on the historic record. Boundaries for these two areas are shown, as well as a boundary for Zone One which includes the numerous earthquakes in the coastal belt. Zone Two is the more stable inland area with the lesser seismicity. Bouguer gravity contours by Bothner, Simpson, and Diment (1980) are shown in Figure 5 along with the postulated seismic zones.

24. The seismicity in the Cape Ann area in relation to magnetic anomalies by Harwood and Zietz (1977) is examined in greater detail in Figure 6. The inner dashed line bounds the offshore area where the largest Cape Ann earthquakes occurred: one MM VII; two MM VIII. Newer offshore data and interpretations* show that the plutonic intrusive rocks continue seaward into the area of the more severe seismic events. The outer dashed line bounds the numerous smaller events. At Cape Ann, the seismicity appears to be directly associated with the heterogeneity caused by complicated masses of magmatic intrusions in the subsurface.

25. Neither the magnetic nor Bouguer anomalies (Figures 4 and 5) show complications at Moodus. There are other magnetic and Bouguer anomalies elsewhere throughout the study area (Figure 5), however, without pronounced seismic events.

* Personal communication, Patrick J. Barosh, Weston Observatory, Boston, Mass.

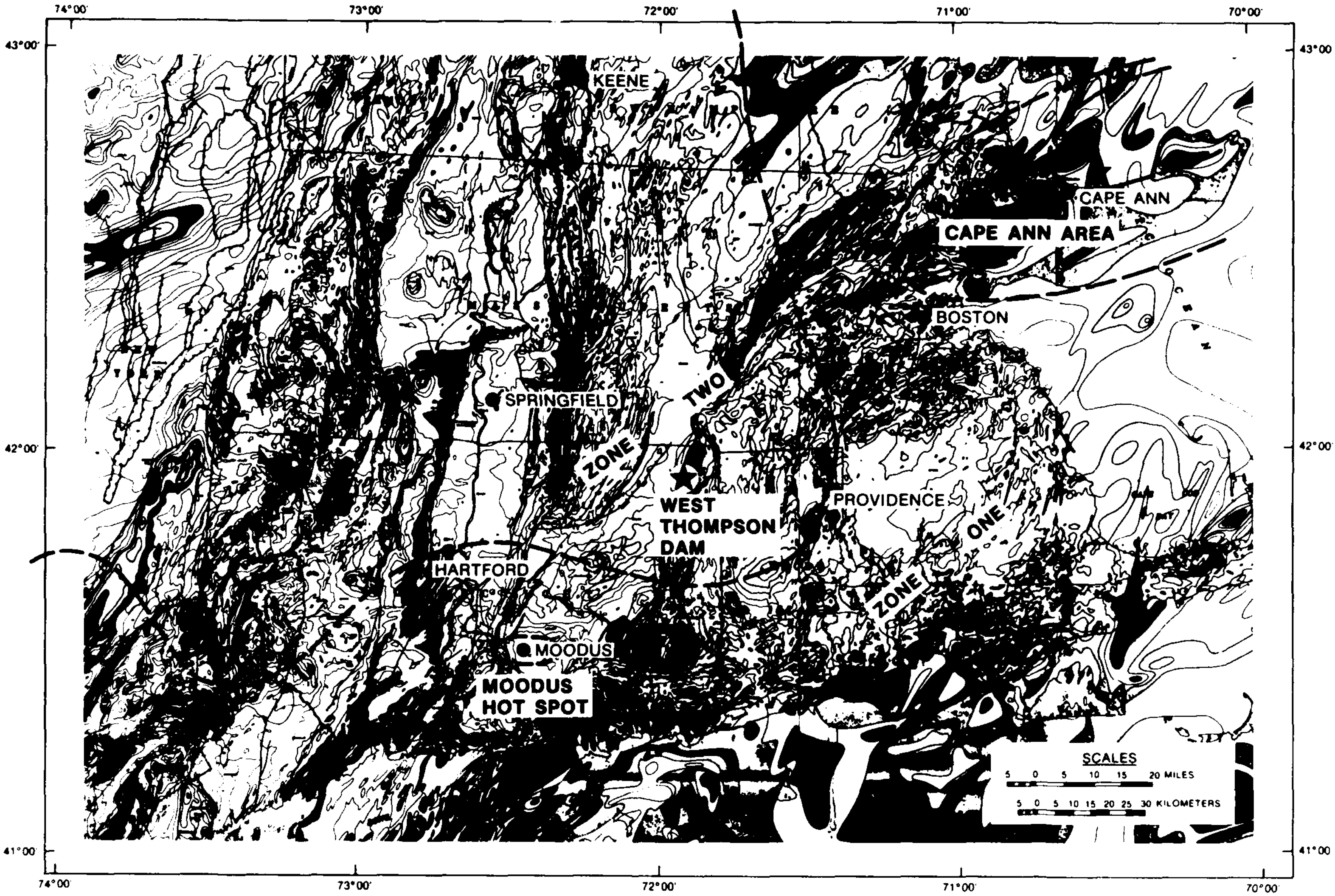

Figure 4. Magnetic anomalies with seismic hot spots (Moodus and Cape Ann) and seismic Zones One and Two; magnetic features from Harwood and Zietz (1977)
(Dark areas show intensest magnetic differences.)

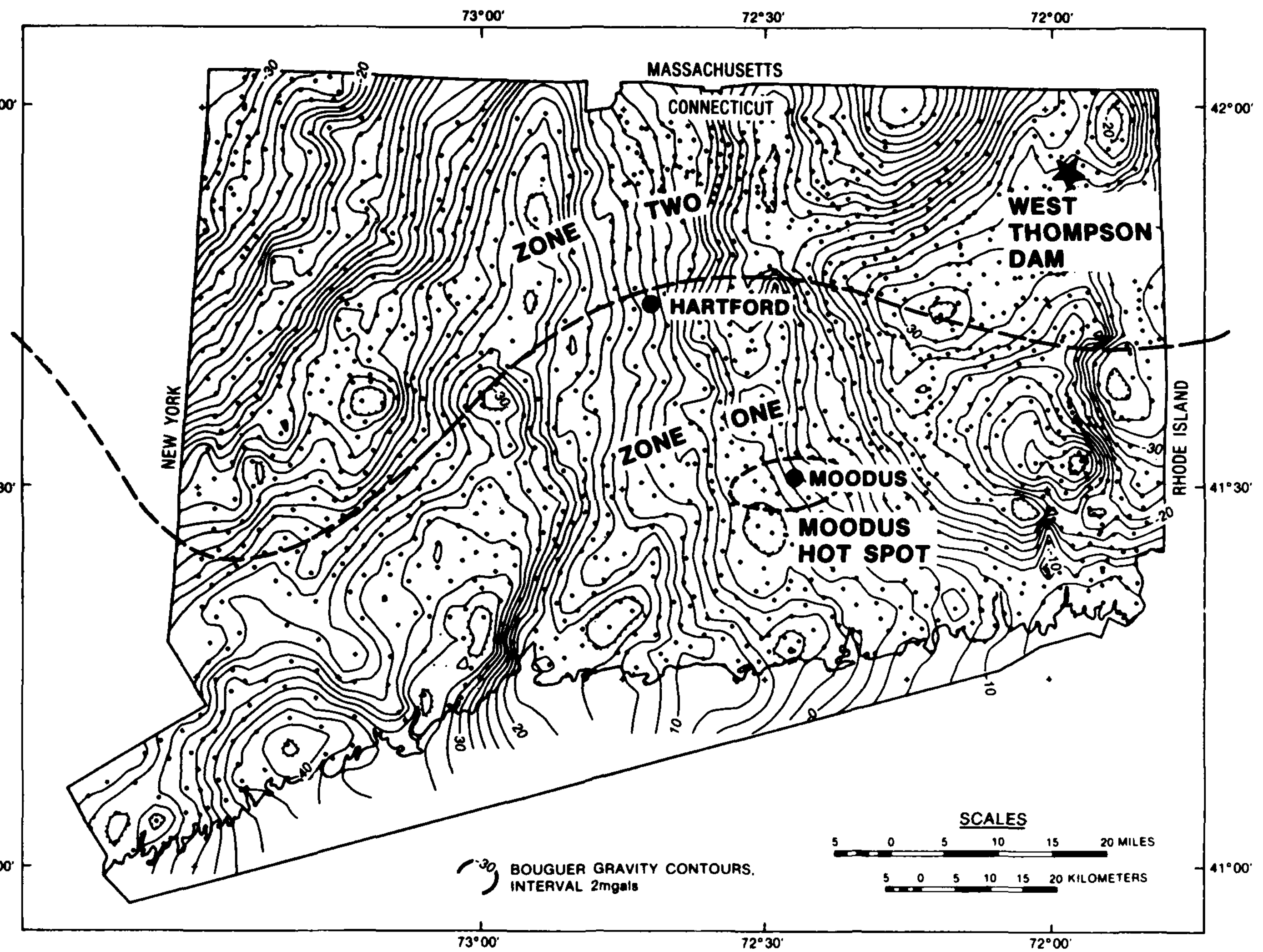

Figure 5. Bouguer gravity contours, seismic hot spot at Moodus, and seismic Zones One and Two; Bouguer gravity from Bothner, Simpson, and Diment (1980)

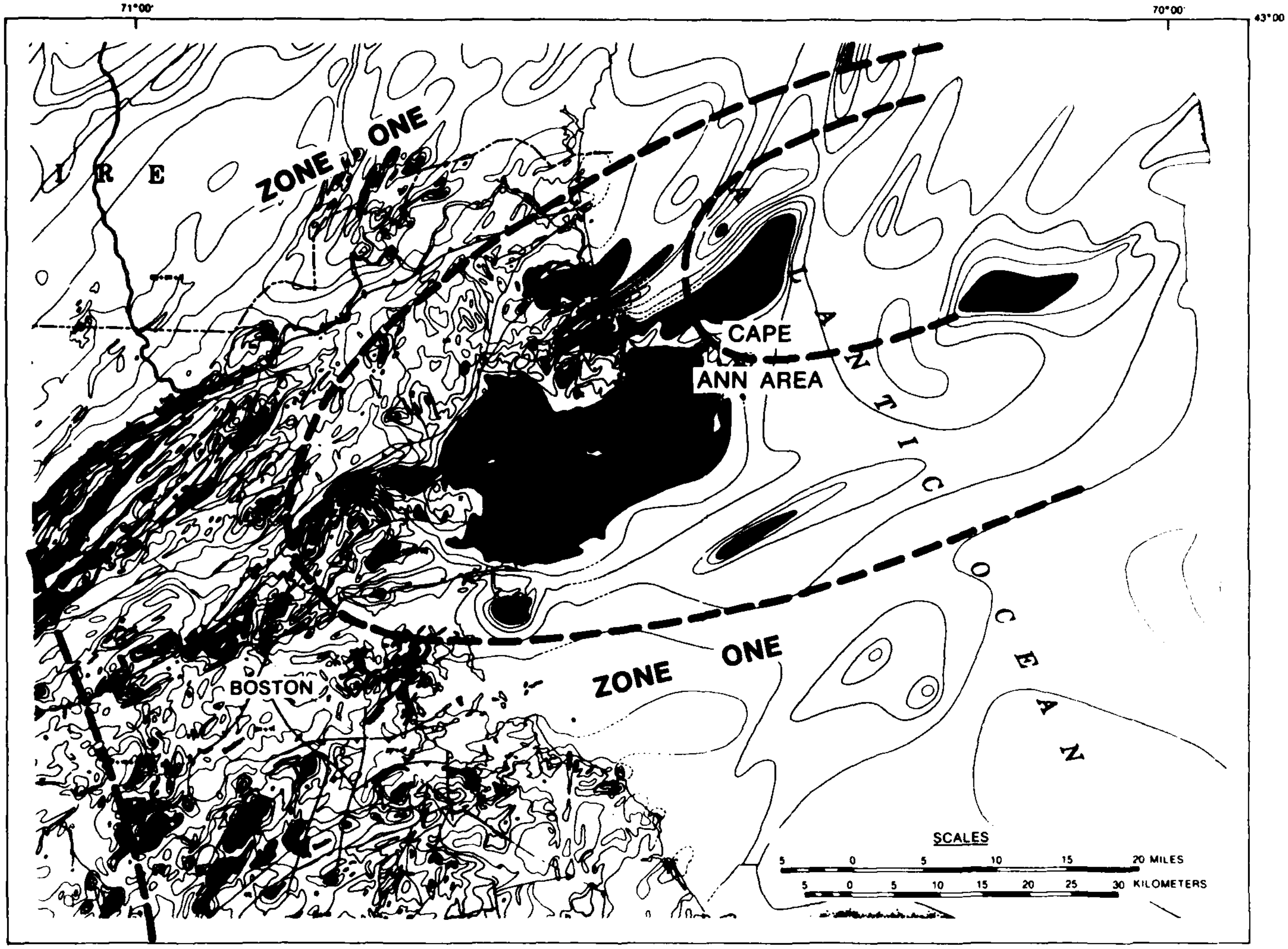

Figure 6. Magnetic anomalies and boundaries of seismicity in the Cap Ann area; magnetic features from Harwood and Zietz (1977) (Dark areas show intensest magnetic differences.)

26. Studies were made by Slemmons and Glass (1978) and Slemmons, Sanders, and Whitney (1980) of faulting in New England. They correlated data from mapped faults, photo lineaments, topographic and aeromagnetic lineaments, and occurrences of intrusive igneous rocks.

27. The faults and linears for the Cape Ann area shown in Figure 7 form a dense and very complicated pattern. A northeast-to-southwest trend extends into the Cape Ann peninsula and parallels the long axis of the Cape Ann seismic trend. The faulting indicated by this trend borders the northern edge of the Cape Ann intrusives. This trend may be the one that relates most directly with the Cape Ann seismicity, though the association is by no means certain.

28. The map of faults and linears in the Moodus area (Figure 8) shows one linear which comes close to the town of Moodus. It is to the north and trends northeast to southwest. There are no mapped faults in this area. To the west and northeast, both faults and linears are prevalent and their density is pronounced. The dominant trend is from northeast to southwest, but a lesser trend is indicated from northwest to southeast.

29. Figure 9 shows some details of the geology in the Moodus area. The earthquakes at Moodus are concentrated in a zone in which the structural pattern is reflected by a linear stretch of the Salmon River and by a series of Triassic dikes that parallel the river. Both have lengths that are 10 km or less. The dikes are intrusions of Triassic age, known as the Higganum dikes, and are composed of diabase rocks. They are the youngest rocks in the area.

30. The linear directions of both the dikes and the Salmon River are most pronounced where they have developed in Devonian schists and gneisses (Figure 9). The linearity becomes lost somewhat abruptly in the older Ordovician rocks to the northeast, and it is terminated by granitic pegmatites that are encountered in the southwest.

31. A field study by Sawyer and Carroll (1981) of minor faults and joint patterns in the dikes showed that they resulted from a stress field having a principal axis of compression in a north-northwest to south-southeast direction. These compressional forces are believed to have affected south-central Connecticut during the past 175 my. Along the Salmon River linear trend, no faults have been recognized.

32. An effort was made by Lafleur (1980) to find surface evidence of faulting or tectonic dislocation of glacial sediments in the Moodus-Haddam

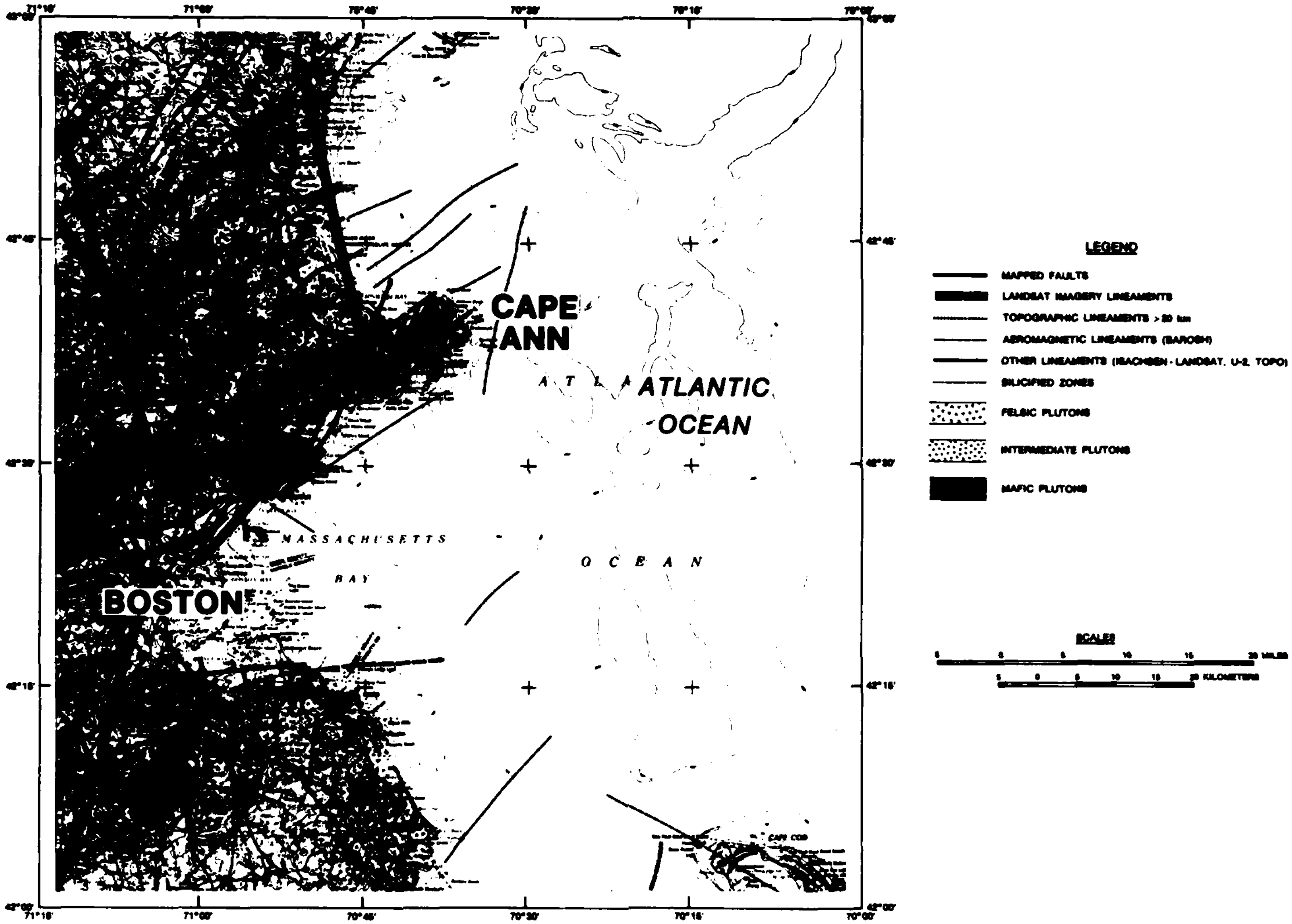

Figure 7. Fault trends and lineations in the Cape Ann area (from Slemmons and Glass, 1978)

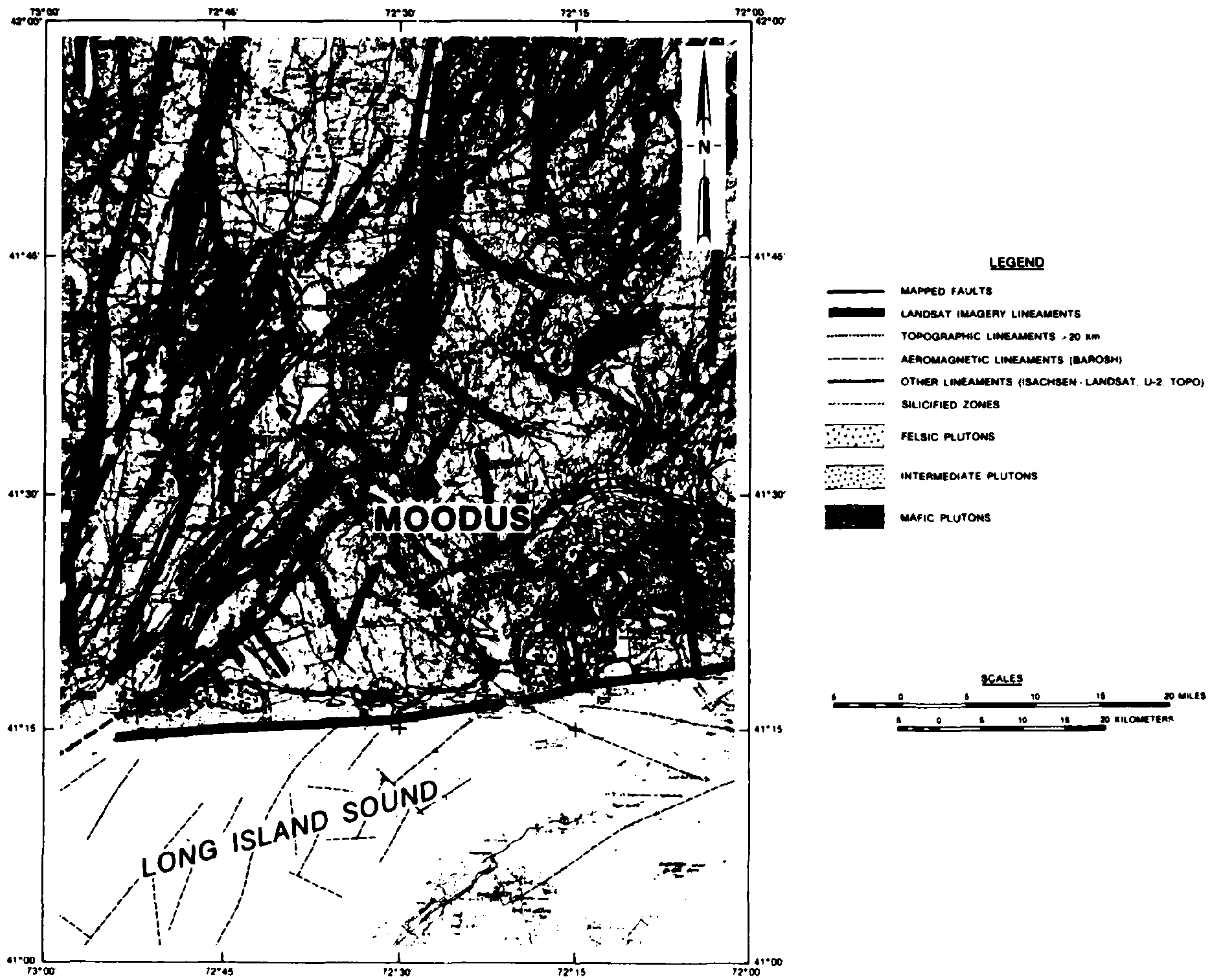

Figure 8. Fault trends and lineations in the Moodus area (from Slemmons and Glass, 1978)

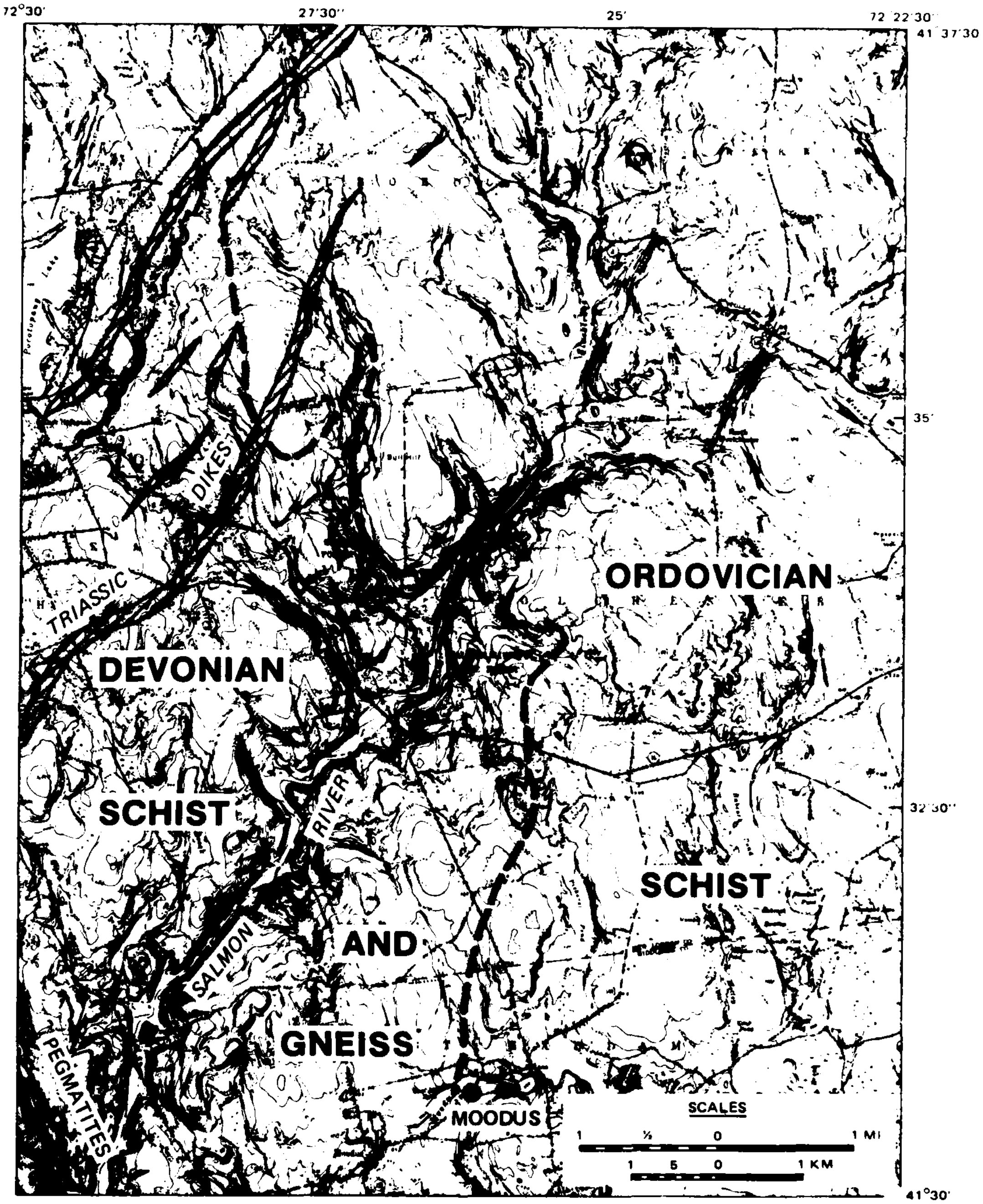

Figure 9. Details of the geology in the Moodus area

area. He found no positive evidence of tectonic disturbance of glacial deposits and saw no indications of offsets in the terrace levels.

33. Slemmons, Sanders, and Whitney (1980) made a review of other surficial evidences of rock displacement that had been noted for parts of Connecticut. About 8 miles northeast of Moodus, small offsets were seen in drill holes made for highway excavations. The offsets are along preexisting foliation or fault planes. However, their occurrence is limited almost completely to highway islands that are a little over 200 ft wide. There are cut islands that are unconstrained on two sides. Bounding highway cuts on only one side show very little or no offset of drill holes. It appears that these offsets represent strain with stress releases but are shallow so that they do not relate to fault movements that might be associated with earthquakes.

34. Slemmons and his associates also examined other very small postglacial offsets. Though some may possibly be tectonic, the effects of glacial rebound or of frostquakes can explain them more reasonably. Slemmons did not recognize any of the small displacements as providing evidence of earthquake-related effects.

35. Figure 10 shows fault trends and lineations in the general area of West Thompson dam. There are no mapped faults at the dam itself. The linears appear to be determined by topographic and stratigraphic patterns in the area. Slemmons made overflights during hours of low sun angle in the area to see if evidences of recency of fault movement could be detected. He found none and concluded from the combined evidence that the faults in New England were dead faults.

36. Though active faults are judged to be absent from the land area of southeastern New England, Barosh (1980) suggests that there may be active high-angle faults that trend northwest to southeast and are described by him as situated subsea off the coast of Connecticut. He did not map their locations. These faults are interpreted from seismic profiles that suggest possible Holocene movement. However, these faults have not been associated with any large or notable earthquakes.

Microearthquakes

37. Microearthquakes recorded by the New England Array for eastern Connecticut (Figure 11) are events of Magnitude 1.8 to 3.2 and were recorded

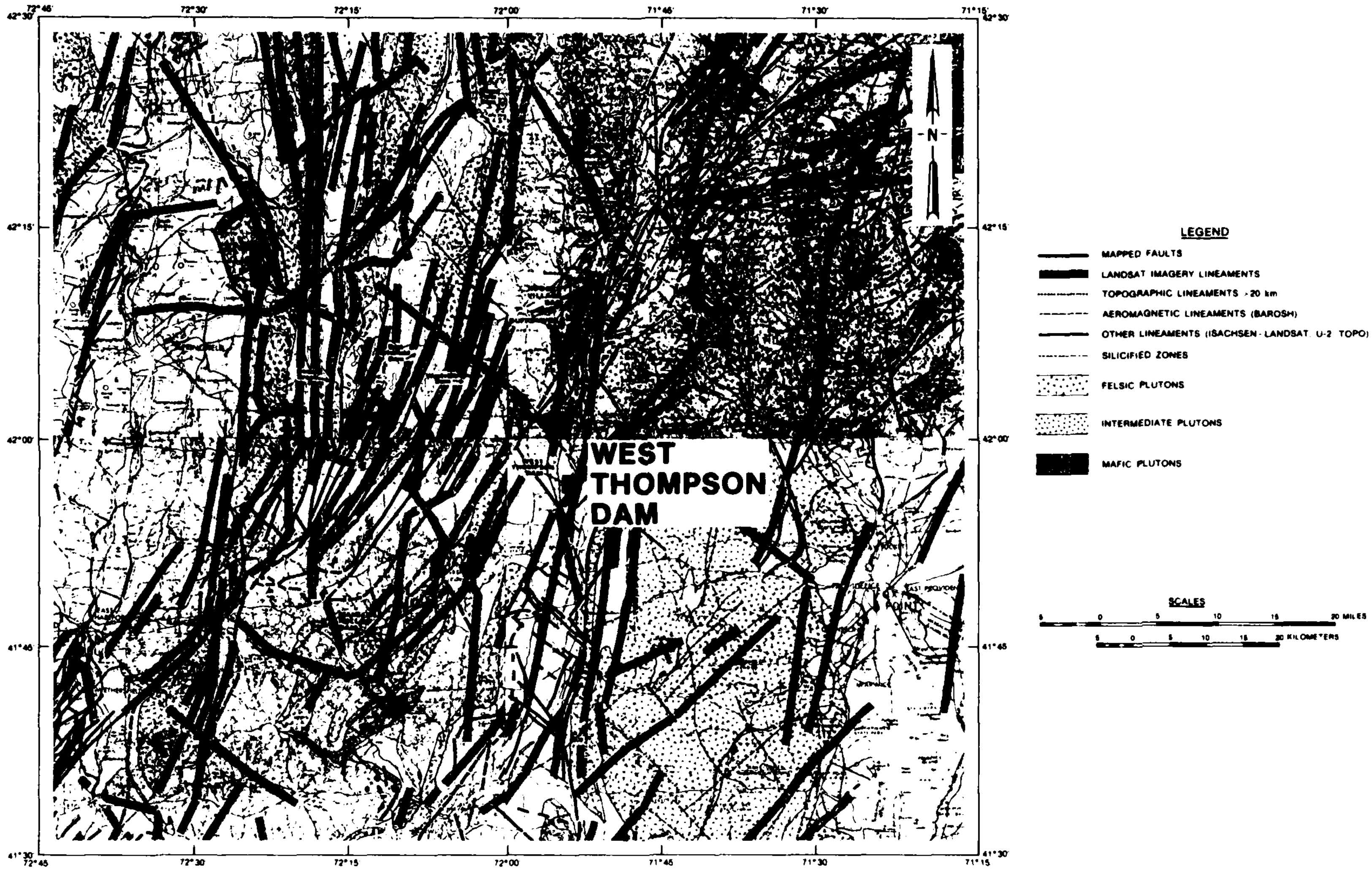

Figure 10. Fault trends and lineations in the area of West Thompson Dam (from Slemmons and Glass, 1978)

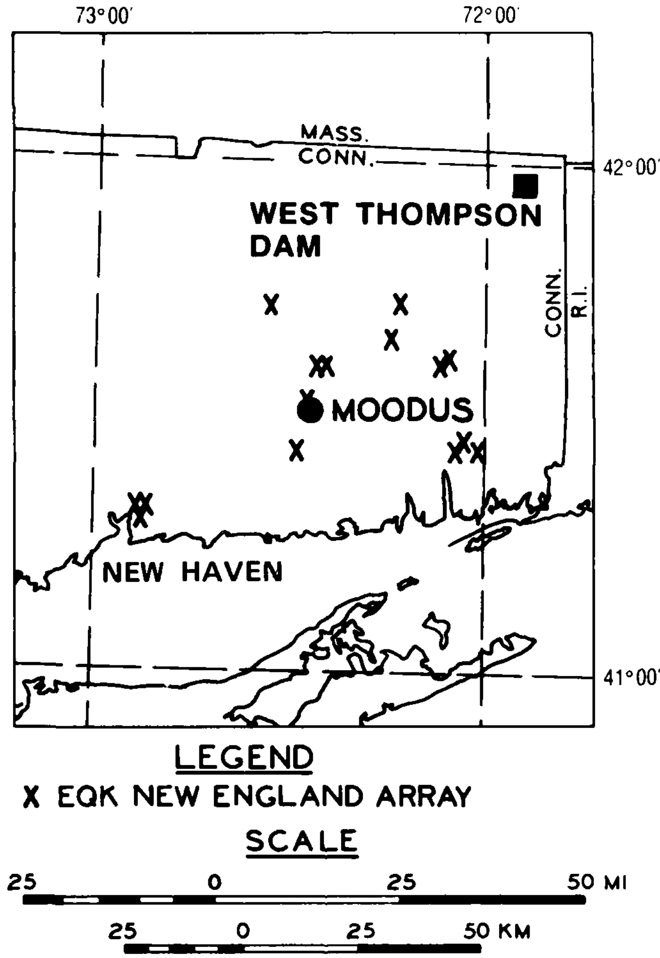

Figure 11. Microearthquakes recorded by the New England Array for eastern Connecticut (1976-1980)

for the period from 1976 to 1980. Table 1 lists the dates, location, sizes, and focal depths.

38. The microearthquakes of these sizes are not especially numerous. They do not relate to any recognizable faults, nor do they identify any particular fault trends or other tectonic evidence. Finally, they are mostly very shallow and are either nonspecified because of their shallowness or calculated on a basis of zero depth. Only one had a depth of 6.7 km, two of 5.6 km, and the rest are less than 1 km. The Moodus area, which historically has been very seismic, recorded only a single event, one that was so shallow that a depth determination could not be made.

39. The prevailing shallowness of all the events is an element of evidence that suggests that these earthquakes do not relate to potential fault activity of the sort that would produce severe earthquakes. No seismic events were recorded within 20 miles of West Thompson dam. Additionally, there are no events in the seismic history which dates back more than 300 years.

Northwest-to-Southeast Seismic Trends

40. Reference to Figure 2 shows that a sort of northwest-to-southeast trend in the seismicity occurs starting at Boston-Cape Ann and extending northwest for about 160 km. Other short and vague trends are seen at New York, Moodus, and Rhode Island.

41. The trend starting at Boston-Cape Ann has been termed the Boston-Ottawa trend and has been connected to join with earthquakes in the St. Lawrence Valley (Fletcher, Sbar, and Sykes, 1978). The Boston-Ottawa trend can also be connected with subsea features in the Atlantic known as the New England (Kelvin) Seamount Chain which extends about 1200 km southeast of Massachusetts. This overall trend, about 2000 km in length, also parallels a trend, postulated by these authors, from Charleston, South Carolina, to New Madrid, Missouri.

42. Fletcher and his associates believe that these trends are the remains of major tectonic zones formed as rifts in the crust during the opening of the western Atlantic in the early Mesozoic, about 190 my ago. They are manifest today as deep crustal sutures with intrusive igneous fillings. They remain as zones of crustal weakness and are also zones where regional stresses can become focused and released. An implication of this theory is that major

earthquakes occurring at any point along these trends can occur anywhere along the full length of the trend.

43. Problems do exist with Fletcher's views. Reference to the magnetic anomalies in Figure 4 and the Bouguer gravity contours in Figure 5 show that the Boston-Ottawa trend is more conceptual than real. Other structural trends that are far more pronounced go north-south and northeast-southwest. The entire region is extremely complex, and the opportunities for focusing of regional stresses and their release are almost unlimited. Polygenetic seismotectonic models are more appropriate than Fletcher's model for a complex region such as this one.

44. These long-distance trends, specifically Boston to Ottawa, are actually very greatly discontinuous where the historic seismicity is concerned. A continuous level of large potential earthquakes along these trends has no justification in the historic evidence. For a region with 400 years of record, one may safely restrict the seismic zones to limits which are indicated by the historic seismic evidence. Thus, to project an earthquake along one of these trends into an area where earthquakes have not occurred is unnecessarily conservative.

Recurrence

45. The mean return period in years for earthquakes at Boston for given MM Intensities calculated by various methods was reported by Acharya, Lucks, and Christian (1982) as follows:

Method	Return Period (years) for MM Intensity in Boston V	VI	VII
Howell and Schultz (1975)	22	120	1,049
Cornell and Merz (1975)	271	2,840	11,990,407
McGuire (1977)	57	296	1,876

46. The above methods envision a grid pattern containing the various estimated sources of earthquakes in the region surrounding the site, the return rate of earthquakes within the grid, and the attenuation of these earthquakes to the site. A weakness in all the methods is that the source areas are determined by personal judgment and the probability approach cannot identify a maximum event. With no maximum event, the probability approach

assumes that, with more and more time, larger and larger earthquakes will happen. Given enough time, a San Francisco earthquake can happen anywhere in New England. No doubt if one thinks back 200 my to the Mesozoic, this view is correct. This lack of a cutoff is reasoned by the probability experts to be no problem because the recurrence rate becomes so infinitesimally small that one can live with it as an acceptable risk. Thus, the Cornell-Merz method derives an enormous recurrence interval, 11 my, for MM Intensity VII, and there would be an exponentially larger number of years for MM VIII and so on. These values should be compared with the number of years for all recorded history, which is only about 5000, and for the life of a typical dam, which is about 150 years. The divergences for the different methods are from the assumptions or personal guesses that are worked into the procedures. These divergences show that there has to be an extremely large range of error within these methods. The range of error is nowhere given.

47. Recurrence anywhere in New England, as opposed to a specific place, was estimated by Chiburis (1980) for various intensity levels as follows:

MM Intensity	M*	Mean Return Time, years
VI	4.6	0.6
	5.0	1.1
VII	5.2	1.5
	5.5	8.8
VIII	5.8	53
	6.0	175
IX	6.4	1,923
	6.5	3,500

* $M = M_S \geq 6.5$ and other magnitudes, not specified, for less than 6.5.

48. For the purposes of this report, the rate of recurrence is not used. A deterministic method is followed whereby maximum earthquakes are interpreted for a source or a zone regardless of time. These earthquakes are either floated to a site, if the site is in the same zone, or attenuated to the site from its source boundary. Appropriate motions are then assigned. The assumptions are that a dam must be designed for the worst that can happen to the structure and that the worst can be specified in a defensible manner without dealing with the uncertainties in calculating time-related events.

PART III: CAUSES OF SEISMICITY IN SOUTHEASTERN NEW ENGLAND

49. Barosh (1981) suggests that most of the seismic activity in southeastern New England can be explained by movement concentrated at structural irregularities along a sagging Atlantic coast and along extensional faults resulting from continued opening of the North Atlantic basin. The sagging coastline of New England was described by Brown and Reilinger (1980). Figure 12 shows the dimensions they cite for apparent secular subsidence. Subsidence varies between rates of 1 and 4 mm/year from Portland, Maine, to New London, Connecticut. Barosh's view is corroborated by the coastal belt of greater seismicity which was previously noted.

50. Possible causes for concentration of seismicity, particularly at the Moodus, Cape Ann, and Ossipee hot spots, are:

a. Focusing of regional stresses at heterogeneities (plutons) in the subsurface and release of the stresses along preexisting faults.

b. Possible small-scale introduction of magmatic material into the plutons at depth with an accompanying buildup of stresses.

c. Focusing and release of regional stresses along the Boston-Ottawa trend (Sbar and Sykes, 1973). The latter is interpreted as an ancient rift with magmatic intrusions and likely to be a zone of weakness.

d. Slow regional compression causing activation of preexisting regional overthrusts (Wentworth and Mergner-Keefer 1980).

e. Extensional movement which activates irregularities in the coastline, principally where major grabens intersect the downwarping. Inland, these forces may cause activation of faults with northwesterly and northerly orientations (Barosh, 1981).

51. The Wentworth and Mergner-Keefer hypothesis and the Sbar and Sykes hypothesis might be interpreted as suggesting that a major earthquake could happen in this region where none has happened before. Such a possibility should not be accepted without some additional evidence. A seismic buildup in a previously nonseismic area would provide such evidence; however, no such activity has been recognized in the area of interest. The remaining hypotheses do not suggest a potential for new areas of seismic activity.

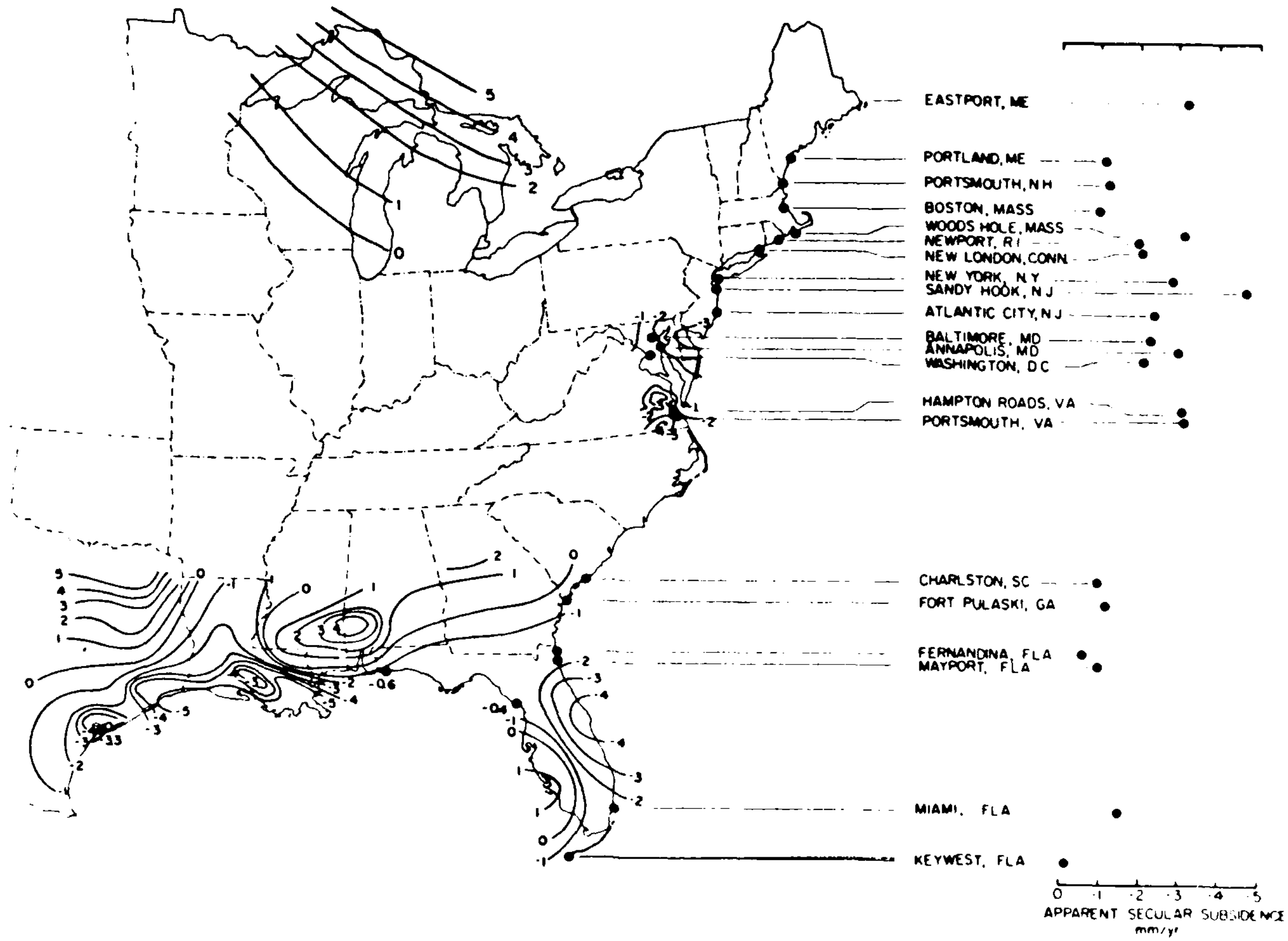

Figure 12. Vertical movement in eastern United States (from Brown and Reilinger, 1980)

PART IV: FELT EARTHQUAKES AT WEST THOMPSON DAMSITE

52. A map was prepared by Barosh (1980) to show composite boundaries of maximum recorded MM Intensities in southeastern New England and is reproduced as Figure 13. The MM Intensity zones are the superimposed maximum intensities for the total historic period. The West Thompson damsite would have experienced a maximum MM Intensity of V during the historic period.

53. For this report, an individual examination was made of all historic earthquakes of MM Intensity VI or greater at their origin that were judged to be felt at West Thompson damsite. These earthquakes are listed chronologically in Table 2. The distances are given in miles from their sources to West Thompson dam, and interpretations are given of corresponding intensity at the damsite. Isoseismal maps were used where available, and attenuations were applied where such maps were not available.

54. According to Table 2, the major earthquakes at New Madrid, Missouri, the St. Lawrence Valley in Canada, and Charleston, South Carolina, were felt to have MM Intensity III or less. The severest historic intensities felt at the damsite were MM V. Those intensities were felt on two occasions: an earthquake at Newbury, Massachusetts, in 1727, and one at Cape Ann, Massachusetts, in 1755. Reference to Figure 13 shows that the hot spot at Moodus produced a maximum MM Intensity at the dam of IV or less during all of historic time.

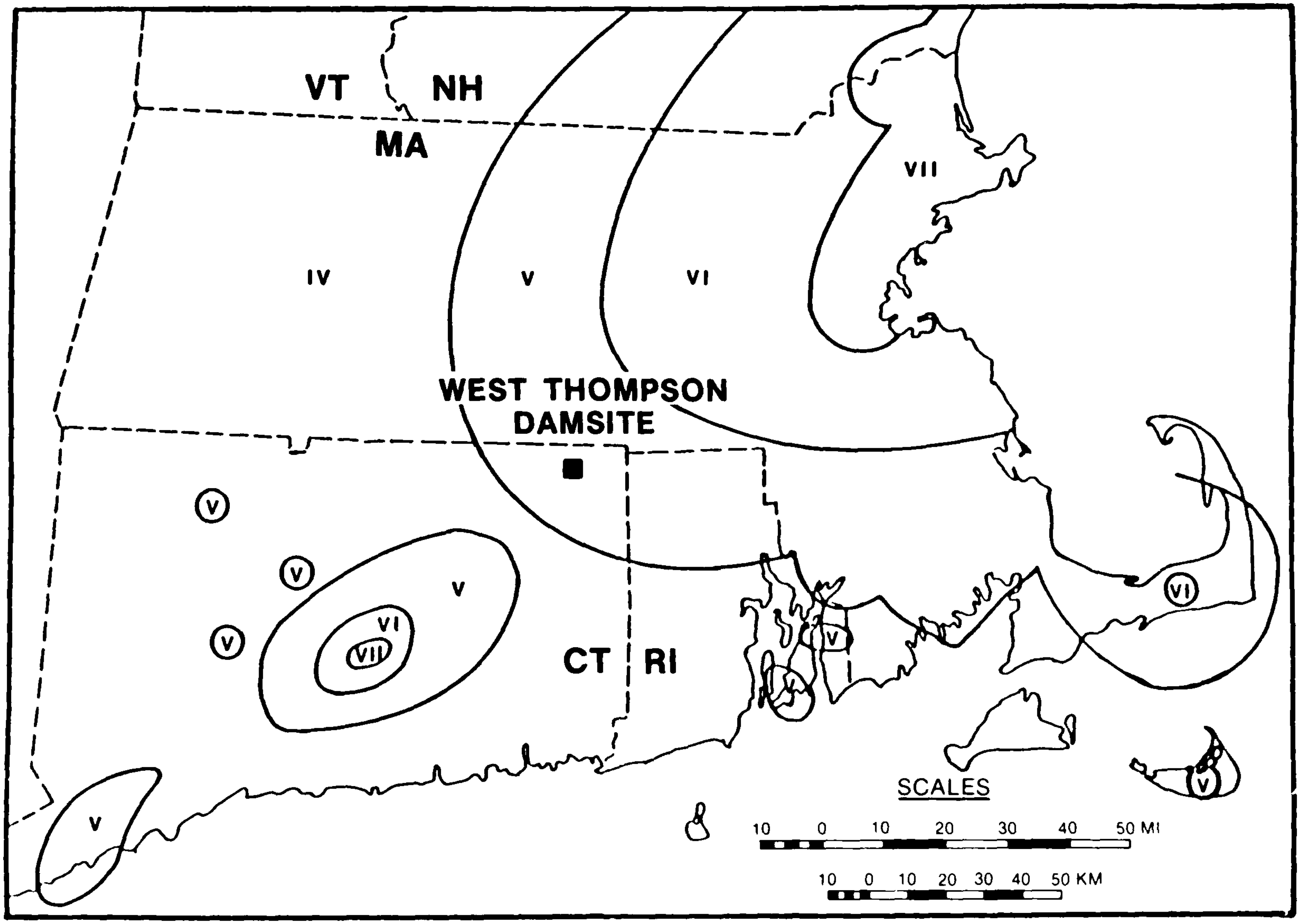

Figure 13. Composite intensities of felt earthquakes in southeastern New England (from Barosh, 1980)

PART V: SEISMIC ZONES AND FLOATING EARTHQUAKES

55. The seismic zones for southeastern New England designated in Figure 14 were developed by the author from the historic seismicity shown in Figure 2 and from the geophysical data considered in the preceding sections of this report. The region was divided into two zones: Zone One - a coastal belt of relatively greater seismicity, and Zone Two - the relatively stable interior region. An interior area in eastern New York is shown as Zone One because of its locally greater seismicity.

56. In the coastal strip, areas of more pronounced seismicity and occurrence of relatively larger earthquakes are termed hot spots. Hot spots are shown at Ossipee, Cape Ann, and Moodus.

57. The seismicity near Concord, New Hampshire, was not treated as a hot spot. The earthquakes never exceeded MM V and were very shallow. The potential future earthquakes at Concord are believed to be no greater than any others in Zone One.

58. Zone One was assigned a floating earthquake of MM Intensity VII. MM VII is one intensity unit higher than the severest intensity experienced in this zone in 400 years. Zone Two was given a floating earthquake of MM Intensity VI on a similar basis.

59. The hot spots were given MM Intensities of VIII, except for the offshore area at Cape Ann. In the latter area where the severest earthquakes in New England have occurred, the intensity levels recorded were MM VIII. The area was given an MM Intensity of IX.

60. In Figure 14, Richter magnitude equivalents are shown for each of the maximum MM Intensities. The magnitudes were based on the general relationships between magnitude and intensity developed by Mitronovas (1982) for New York and adjacent areas.

61. In all cases, the assigned maximum earthquakes are equal to or greater than those of the 400-year seismic history. The maximum earthquakes also are as great as the severest alternate interpretations of earthquake intensity in the Chiburis catalogue. The boundaries of the zones are also more encompassing, meaning that they provide for more severe earthquakes, than are the composite historic intensities (Figure 13) compiled by Barosh (1980).

62. Within each zone, a floating earthquake should be moved to any site in the zone. A larger source, such as in a hot spot, should be attenuated to

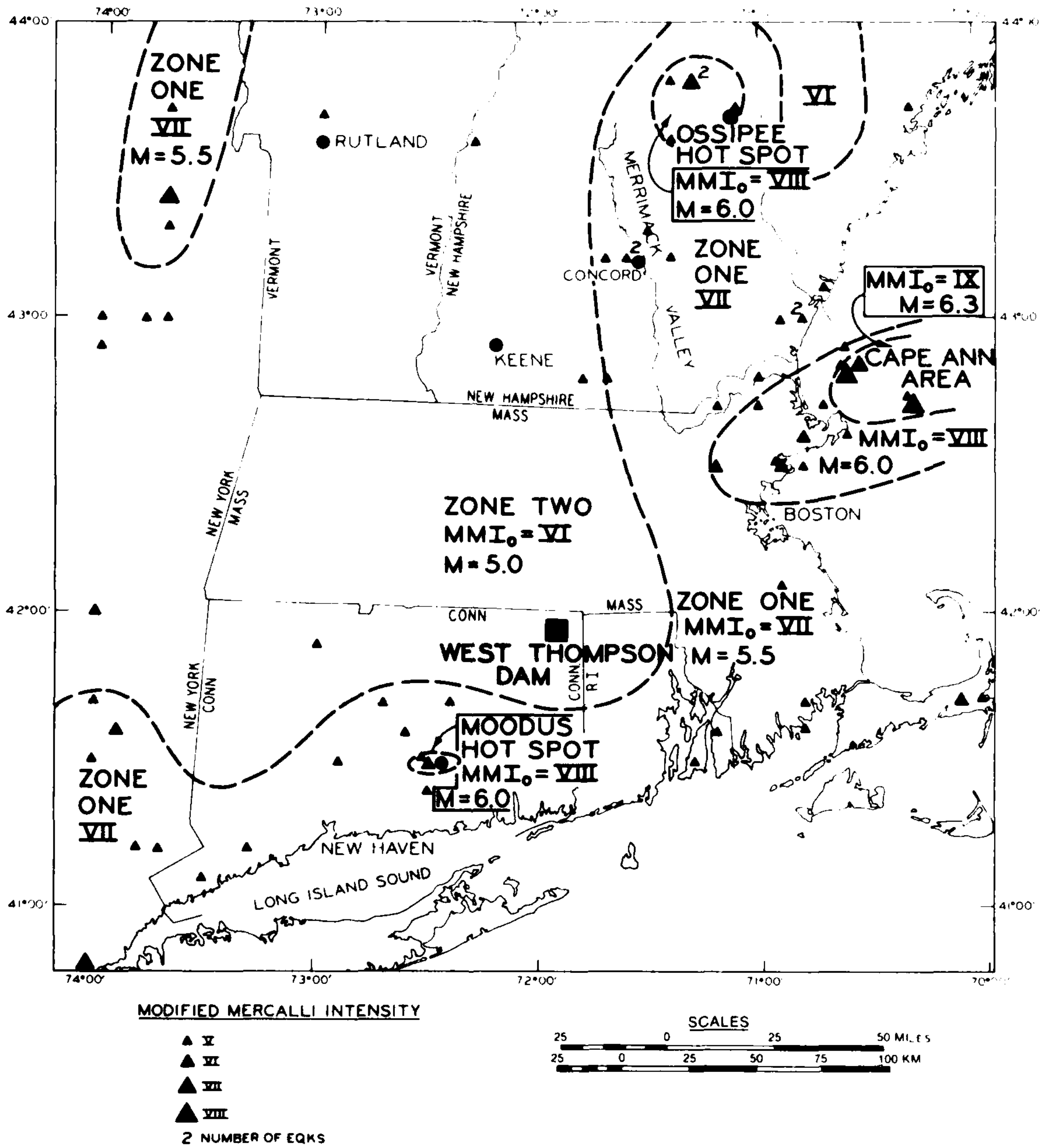

Figure 14. Seismic zones in southeastern New England

a site outside of the hot spot from a point that is on the boundary of the hot spot nearest to the site.

PART VI: EARTHQUAKE MOTIONS AT WEST THOMPSON DAMSITE

63. The values for floating maximum earthquakes given in Figure 14 are as follows:

Area		MM Intensity	Richter Magnitude
Zone One		VII	5.5
Zone Two		VI	5.0
Moodus		VIII	6.0
Ossipee		VIII	6.0
Cape Ann:	Outer Area	VIII	6.0
	Inner Area	IX	6.3

64. The attenuation procedure selected for this study uses the diminution of intensity with distance as determined by Chandra (1979). The curves are shown in Figure 15. Chandra's curve for Eastern Province was used.

65. The areas that could produce earthquakes of possible significance to engineering at West Thompson damsite, their distances, and the maximum interpreted intensities at source (I_o) and site (I_s) are as follows:

Source	Distance km	MM I_o	MM I_s
Southern Connecticut, Zone One	30	VII	VI
Moodus, Connecticut, Hot Spot	60	VIII	VI-VII
New York-Vermont, Zone One	198	VII	IV
Ossipee, New Hampshire, Hot Spot	185	VIII	V
Cape Ann, Massachusetts, Outer Area	80	VIII	VI
Cape Ann, Massachusetts, Inner Area	134	IX	VI-VII
Local	0	VI	VI

66. Field conditions, whether near or far, are judged by the following magnitude and distance values given by Krinitzsky and Chang (1977):

Richter Magnitude M	MM Maximum Intensity I_o	Radius of Near Field km
5.0	VI	5
5.5	VII	15
6.0	VIII	25
6.3-6.5	IX	35

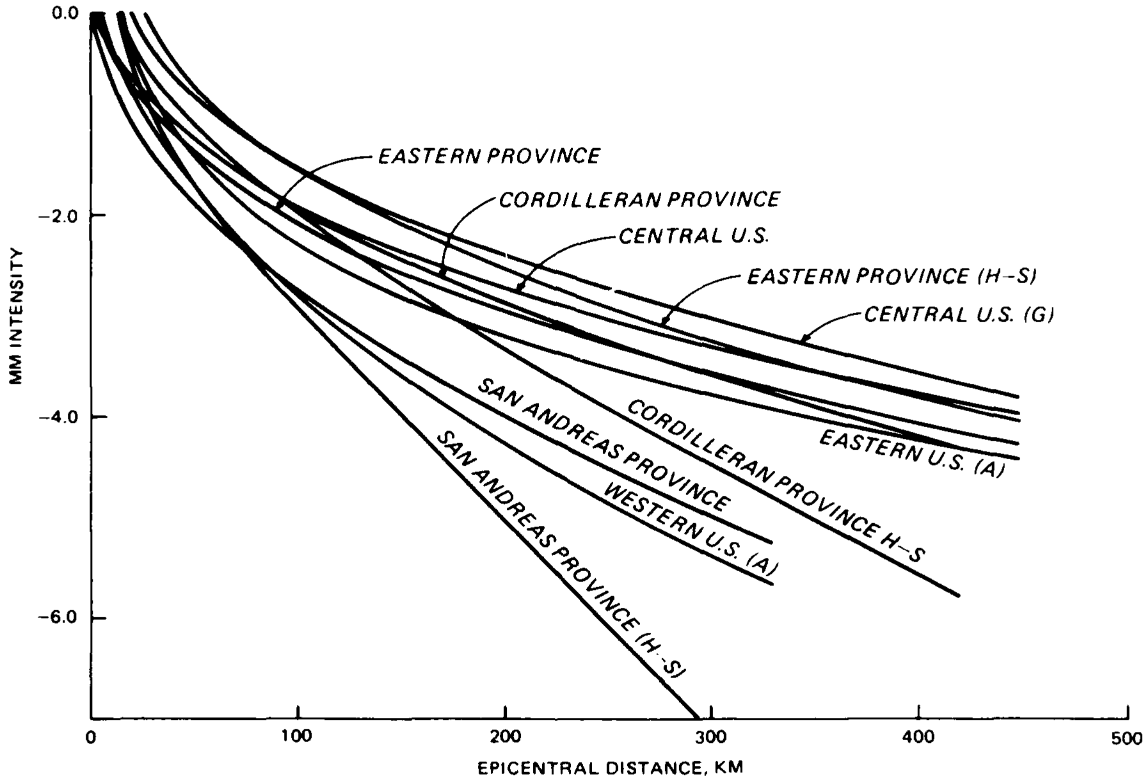

Figure 15. Attenuation of MM Intensities with distance (A = Anderson; G = Gupta; H-S - Howell-Schultz) (from Chandra, 1979)

67. In the near field, there are effects of asperities in the fault planes, complicated reflection and refraction of waves, resonance effects, and impedance mismatches so that a large range in ground motions is possible. In the far field, the wave patterns are more muted, more orderly, and more predictable.

Recommended Motions

68. The West Thompson damsite is susceptible to earthquakes as follows:

a. Zone Two. A floating earthquake that may come to the site: near field, MM intensity VI, M = 5.0.

b. Cape Ann, Inner Area. An earthquake of MM Intensity IX, attenuated to the site. The distance is 134 km, thus the motions are far field. The Chandra attenuation is 2.5 intensity units; intensity at the site is from MM VI to VII.

c. Moodus. An earthquake of MM Intensity VIII, attenuated to the site. The distance is 60 km, thus far field. The Chandra attenuation is 1-1/2 intensity units, thus MM VI-VII at the site. Moodus may be eliminated as a source for calculation since its motions are comparable to those for Cape Ann.

69. The parameters for earthquake motions specified in this report are horizontal peak acceleration, velocity, and duration. Duration is bracketed duration ≥ 0.05 g. Values are for free-field motions on rock at the surface.

70. The curves used for relating MM Intensity to earthquake motions are those of Krinitzsky and Chang (in preparation), which are as follows: Figures 16, 17, and 18, for acceleration, velocity and duration, respectively, for a hard site in the near field; and Figures 19, 20, and 21 for acceleration, velocity, and duration, respectively, for a hard site in the far field. Peak motions are expressed on the charts as mean, mean plus one standard deviation, mean plus two standard deviations, and maximum observed values.

71. The values are summarized as follows:

Earthquake	Distance km	MM I_o	MM I_s	M		Acceleration g	Velocity cm/sec	Duration ≥ 0.05 g sec
Zone Two	--	VI	VI	5.0	Mean:	0.08	7	3
					Mean + σ:	0.16	13	4
					Mean + 2 σ:	0.22	22	7
Cape Ann (Inner Area)	128	IX	VI-VII	6.3	Mean:	0.08	8	3
					Mean + σ:	0.13	13	4
					Mean + 2 σ:	0.17	20	9

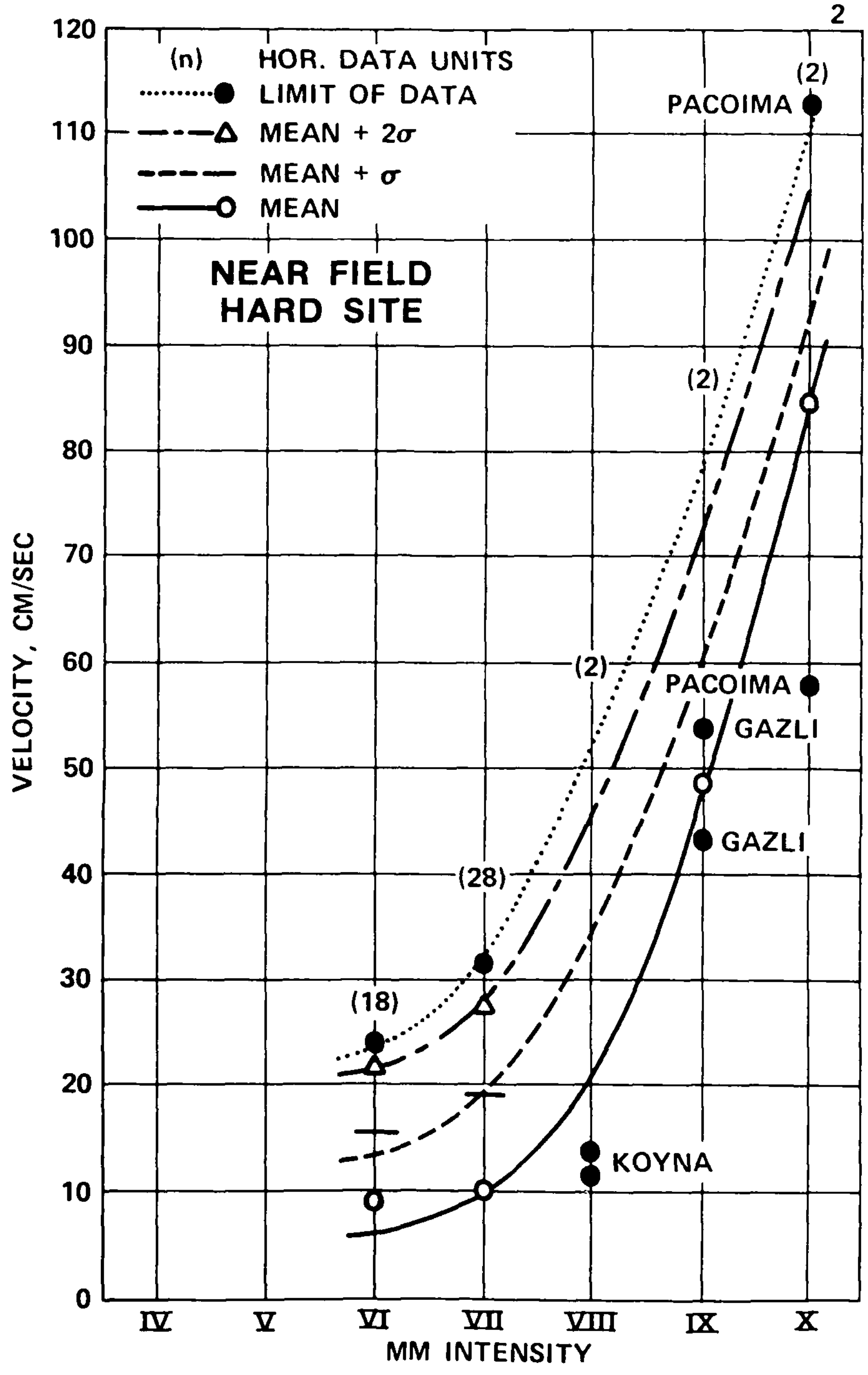

Figure 17. Krinitzsky-Chang curves for velocity versus MM Intensity: near field, hard site

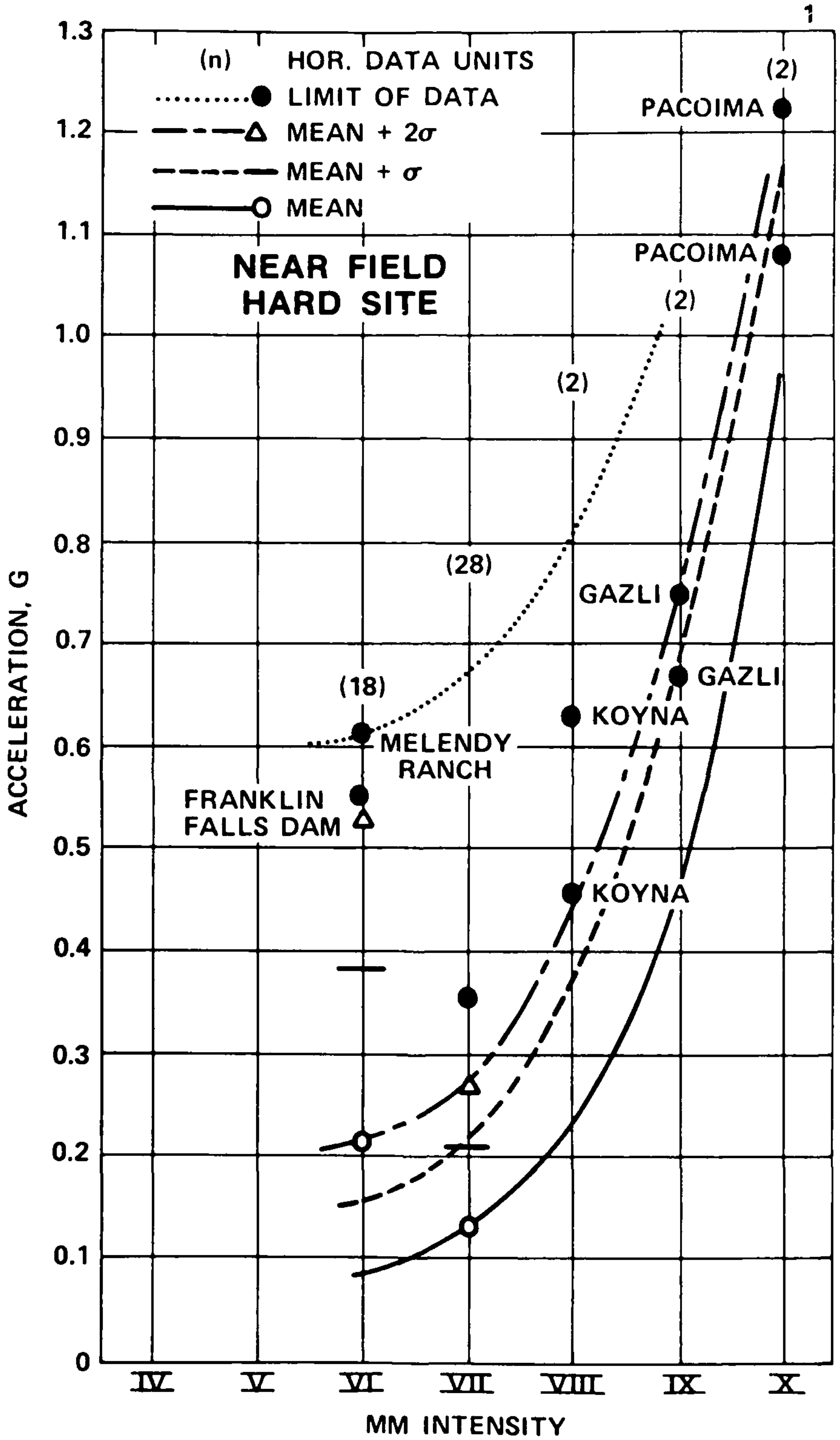

Figure 16. Krinitzsky-Chang curves for acceleration versus MM Intensity: near field, hard site

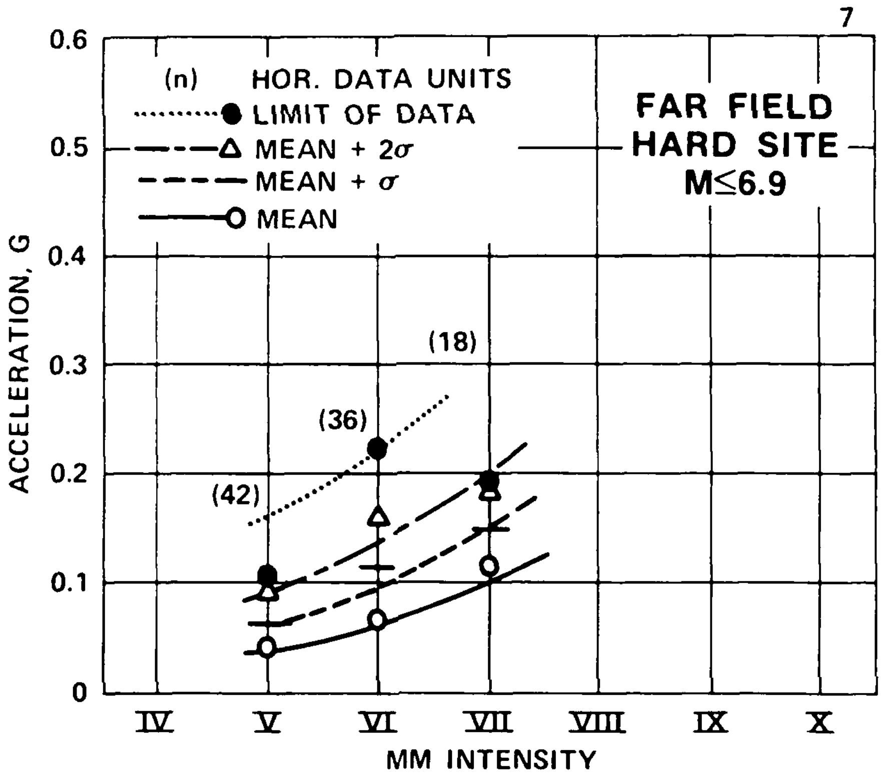

Figure 19. Krinitzsky-Chang curves for acceleration versus MM Intensity: far field, hard site, M $\leq$ 6.9

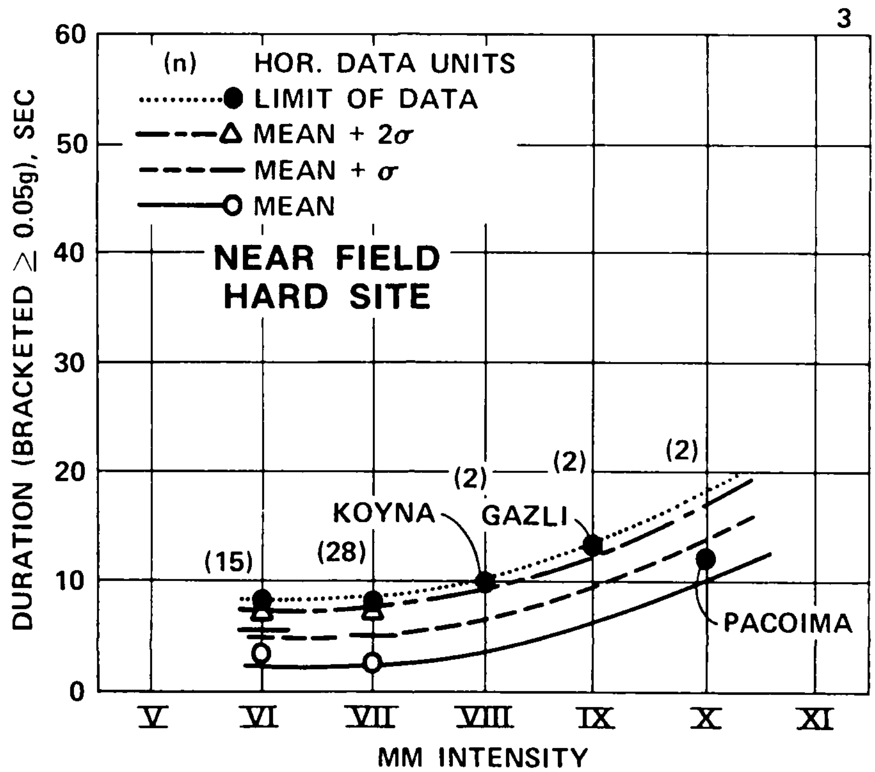

Figure 18. Krinitzsky-Chang curves for bracketed duration ($\geq$0.05 g) versus MM Intensity: near field, hard site

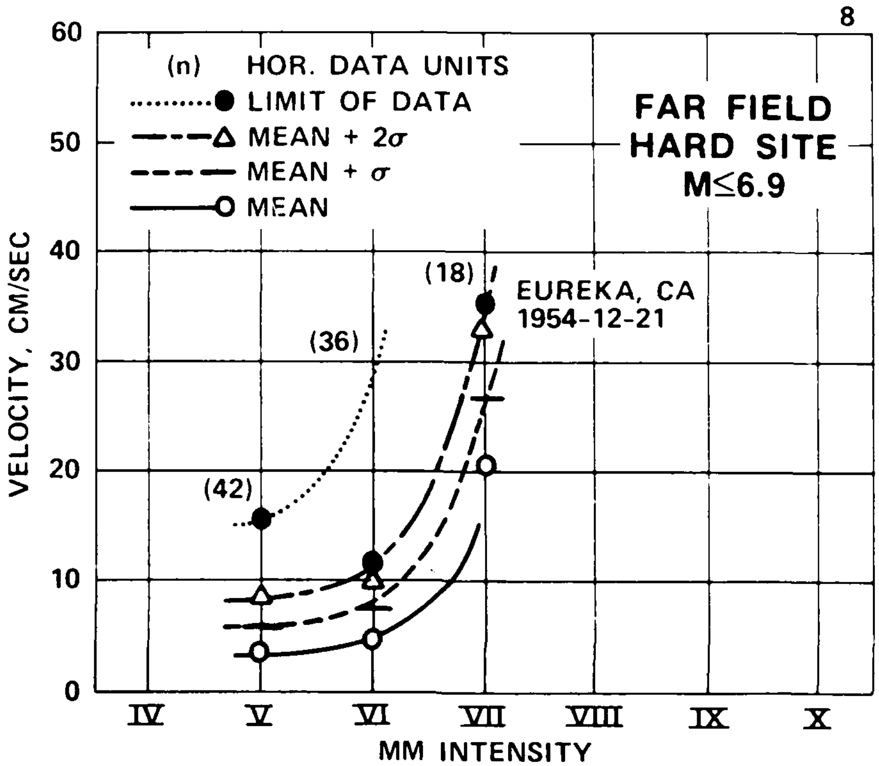

Figure 20. Krinitzsky-Chang curves for velocity versus MM Intensity: far field, hard site $M \leq 6.9$

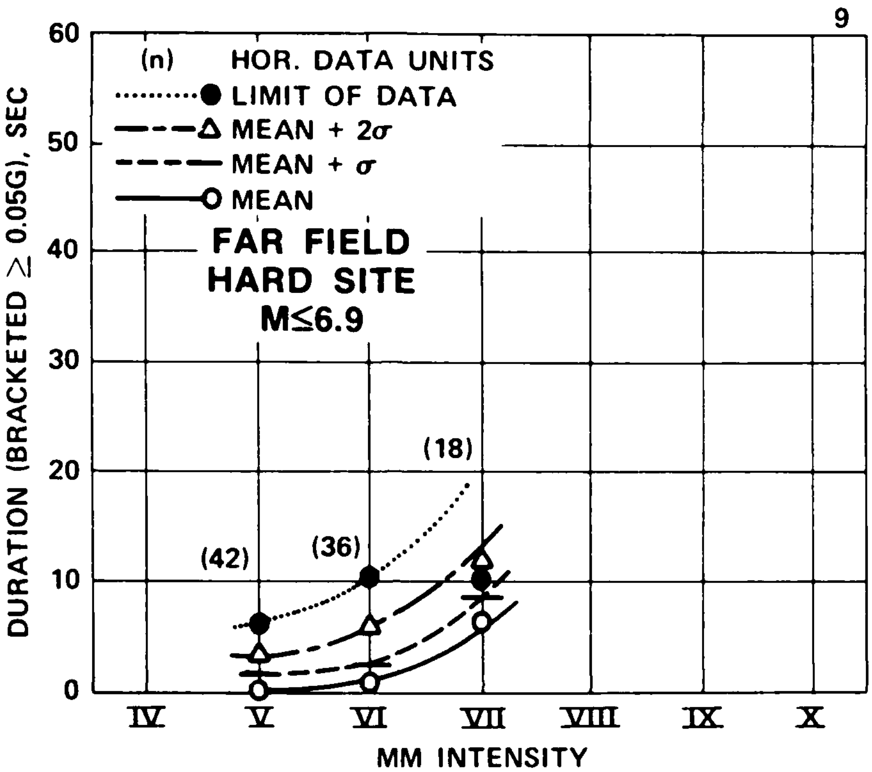

Figure 21. Krinitzsky-Chang curves for bracketed duration (>0.05 g) versus MM Intensity: far field, hard site, M ≤ 6.9

72. Peak motions that are recommended are the mean + σ or 84 percentile. Values at this level put one in a conservative position. For the near field, the mean + 2σ would be appropriate only if a proven causative fault were present at or adjacent to the site. Clearly that is not the case at West Thompson. For the Cape Ann earthquake, the mean + 2σ would represent some special circumstance of focusing of waves or other amplification and may be taken as excessively conservative since conservatism is already built into the analysis by intensities greater than those observed in 400 years.

73. On Figure 16 one notes some very high values, over 0.5 g, for accelerations at Melendy Ranch and Franklin Falls dam. These are high-frequency, high-spiked acceleration peaks with low energy. Using Nuttli's (1979) criterion of sustained motion for measuring peak values, these values are not considered to be valid for design purposes unless one must design structural components with natural frequencies of 10 to 25 Hz.

74. Near field motions for a local earthquake, as presented in this report, are conservative. Far field motions for a local earthquake are more reasonable if it is assumed that the likelihood of an event occurring at a site is remote. However, had the 18 January 1982 New Hampshire earthquake of M = 4.7 been of a greater magnitude as postulated for its zone, that is, as great as M = 5.5, there would have been more powerful near field motions at Franklin Falls dam than those which were recorded (Chang 1983). On this basis, the assignment of near field motions at West Thompson dam was judged more defensible.

75. Thus, the recommended values for mean + σ for peak motions are as follows:

	Acceleration g	Velocity cm/sec	Duration $\geq$0.05 g sec
Zone Two	0.16	13	4
Cape Ann (Inner Area)	0.13	13	4

Recommended Accelerograms

76. Table 3 includes a selection of four accelerograms for Zone Two: near field, hard site. Table 4 lists three accelerograms for Cape Ann (Inner

Area): far field, hard site, with indicated scaling factors. The data for these accelerograms are from records processed by the California Institute of Technology (1971-75), as shown in Appendix B.

77. The four near field records require no scaling or other adjustments. The distances of the records, source to site, are on the order of 30 km rather than at a site. However, they represent the specified motions and are close enough to their sources to provide near field conditions.

78. Of the far field accelerograms, one is from a hard site and two are from soft sites. Sufficient records from hard sites were not available. For the distances that the latter are from their sources, 65 to 119 km, the differences between hard and soft sites are diminished, and records from these sites can be substituted for each other if necessary. Also, moderately more severe earthquakes were used, M = 6.5 to 7.2, than those postulated for the Cape Ann Inner Area. Selection of these earthquakes was necessary in order to provide the desired motions with scaling factors no greater than 2.0. This limit on the scaling factor is desirable in order to avoid possible distortions in the spectral content of the records. The duration of shaking in these records must be reduced to the time interval of 4 sec by deleting portions of the records on a proportional basis.

79. The records in Tables 3 and 4 are by no means the only records that may be used, but they are presented as appropriate accelerograms. If a single most appropriate record is to be specified for the near field, L166 (Table 3) most closely approximates the specified conditions; for the far field, P223 (Table 4) is recommended. The design earthquake appears to be controlled by the far field Cape Ann event.

Comparison of West Thompson Motions with Those for Nearby Nuclear Power Plants and Dams

80. Figure 22 shows the locations of nuclear power plants in southeastern New England. Most of these plants were constructed along or near the coast and, consequently, are in seismic areas that are different from the Zone Two of West Thompson dam. The only nuclear power plants in Zone Two are Yankee and Vermont Yankee. Peak motions for those sites are available only as accelerations, as follows:

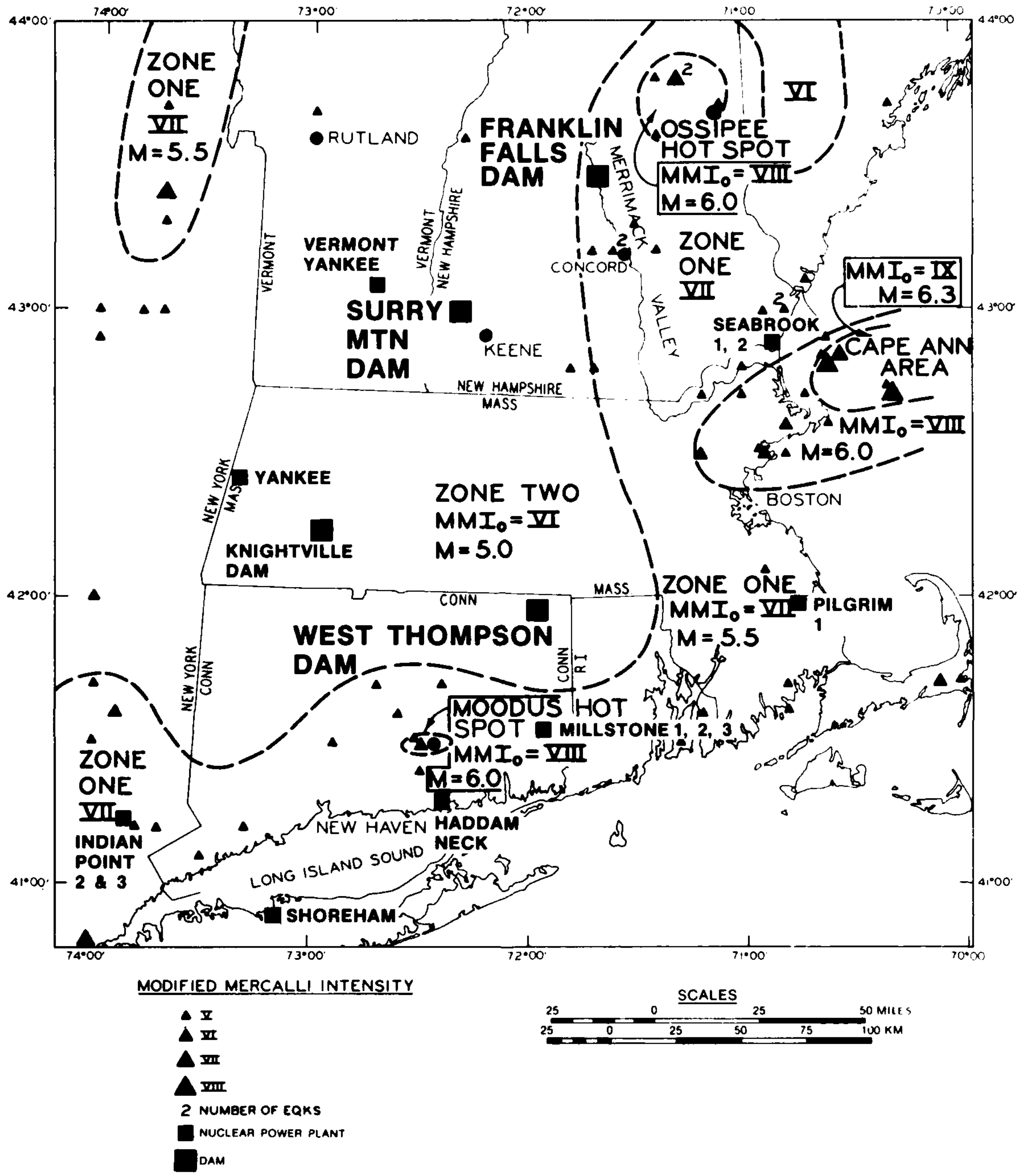

Figure 22. Locations of nuclear power plants and selected dams in southeastern New England

<u>Yankee</u>: A seismic coefficient was used which is interpreted to be the equivalent of an acceleration of 0.15 g.

<u>Vermont Yankee</u>: Acceleration equals 0.14 g.

The above values appear to be reasonably in accord with the accelerations of 0.16 g and 0.13 g specified for West Thompson damsite.

81. The only dam in the area that was analyzed to provide motions for a dynamic analysis was Knightville in west-central Connecticut (Figure 22). A comparison of recommended earthquakes and their peak motions (Toksoz 1982) is given below:

	Knightville Dam	West Thompson Dam
Local Earthquake		
Epicentral Distance	12 km	At site
Acceleration	0.25 g, high-frequency motion	0.16 g
Velocity	3.32 cm/sec	13 cm/sec
Duration	"short," value not given	4 sec
Cape Ann Earthquake		
Distance	175 km	134 km
Acceleration	0.2 g	0.13 g
Velocity	10.6 cm/sec	13 cm/sec
Duration	10 sec	4 sec

As indicated above, the Cape Ann earthquake motions for Knightville Dam are conservative compared with values at West Thompson dam, especially since West Thompson is 41 km closer to the source. The local earthquake for Knightville is relatively much less severe.

PART VII: CONCLUSIONS

82. A seismic zoning was developed for southeastern New England based on the geologic structure and the historic seismicity. The zones are principally a relatively active coastal band and a stable interior area. Within the coastal band are seismic hot spots designated as Ossipee, Cape Ann, and Moodus (Figure 14). Since southeastern New England has no identifiable active faults, floating earthquakes were assigned to these respective areas.

83. The West Thompson damsite is susceptible to a floating earthquake at the site as follows: (a) distance - local (Zone Two), (b) MM Intensity - VI, and (c) magnitude (M) - 5.0. In addition, an earthquake from the inner area of the Cape Ann hot spot provides the following: (a) distance - 128 km, (b) MM Intensity at the damsite - VI to VII, and (c) M - 6.3.

84. Recommended values of peak motions (mean + σ of the spread in the data) based on the MM Intensity-ground motion relationships of Krinitzsky-Chang (in preparation) are given below.

	Acceleration g	Velocity cm/sec	Duration $\geq$ 0.05 g sec
Local Earthquake	0.16	13	4
Cape Ann Earthquake	0.13	13	4

Accelerograms and response spectra (Appendix B) are included as representative of appropriate ground motions.

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Table 1

Earthquakes Recorded by the New England Array in Eastern Connecticut, 1976 to 1980

Date	Locality	Latitude degrees	Longitude degrees	Magnitude Nuttli, M_N	Depth km
06 Feb 76	Mansfield, Connecticut	41.74N	72.22W	1.9	--
07 Mar 76	Marlbourogh, Connecticut	41.60N	72.42W	1.8	--
06 Apr 76	East Haddam, Connecticut	41.46N	72.49W	1.8	--
24 Apr 76	East Haddam, Connecticut INT-IV	41.46N	72.49W	2.2	--
30 Apr 76	East Haddam, Connecticut	41.46N	72.49W	1.8	--
30 Apr 76	East Haddam, Connecticut	41.46N	72.49W	1.9	--
17 Dec 76	Southeastern Connecticut (Heard)	41.47N	72.07W	2.2	--
07 Feb 77	Marlbourogh, Connecticut	41.60N	72.43W	2.1	--
07 Jan 79	Connecticut, East Glastonbury	41.73N	72.57W		--
12 Dec 79	Connecticut, SE of Norwich	41.45N	72.01W		--
02 Jan 80	Connecticut, Near Norwich	41.62N	72.10W		--
29 Jun 80	Connecticut, N of Norwich (Foreshock)	41.61N	72.12W	1.5	--
29 Jun 80	Connecticut, N of Norwich	41.46N	72.09W	1.8	--
28 Jul 80	Connecticut, N of Moodus	41.52N	72.45W		5.60
05 Sep 80	Connecticut, SW of Willimantic	41.67N	72.25W	1.8	--
24 Oct 80	Connecticut, NE of New Haven (Felt)	41.32N 41.33N	72.87W 72.87W	2.8 3.2	6.68 1.15
25 Oct 80	Connecticut, NE of New Haven (Aftershock Felt)	41.33N 41.33N	72.88W 72.88W	2.7 3.1	5.54 0.89

Table 2

Earthquake Intensities (MM) at the West Thompson Damsite (I_o = VI to XI)

Date	Latitude degrees	Longitude degrees	Locality	MM I_o	MM I_s	Distance miles
11 Jun 1638	47.6	70.1	St. Lawrence	IX	II	400
05 Feb 1663	47.6	70.1	St. Lawrence	X	II	400
10 Nov 1727	42.8	70.6	Newbury, MA	VII	V	150
17 Nov 1727	42.8	70.6	Cape Ann, MA	VIII	V	85
16 Sep 1732	45.5	73.6	St. Lawrence	VIII	III	270
14 Jun 1744	42.5	70.9	E. Mass.	VI	III	85
18 Nov 1755	42.7	70.3	Cape Ann, MA	VIII	V	85
16 Dec 1811	36.6	89.6	New Madrid, MO	XI	III	1100
23 Jan 1812	36.6	89.6	New Madrid, MO	XI	III	1100
07 Feb 1812	36.6	89.6	New Madrid, MO	XI	III	1100
17 Oct 1860	47.5	70.1	Canada	VIII-IX	III	400
20 Oct 1870	47.4	70.5	Canada	IX	III	400
01 Sep 1886	32.9	80.0	Charleston, SC	X	II	880
21 Mar 1904	45.0	67.2	SE ME	VII	III	310
10 Feb 1914	45.0	76.9	Canada	VII	II	390
01 Mar 1925	47.6	70.1	St. Lawrence	IX	IV	400
20 Apr 1931	43.4	73.7	Lake George, NY	VII	III	135
19 Oct 1939	47.8	70.0	Canada	VI	II	400
20 Dec 1940	43.5	71.17	Ossipee, NH	VII	IV	135
24 Dec 1940	43.5	71.17	Osspiee, NH	VII	IV	135
05 Sep 1944	44.98	74.90	Massena, NY	VIII	III	270
18 Jan 1982	43.5	71.6	NH	VI	III	85

Table 3

Selected Accelerograms;
Zone Two, Near Field, Hard Site

C.I.T. Catalogue No.	Recording Station	Site Condition	Date	Instr. Comp.	Peak Acc. cm/sec^2	Peak Vel. cm/sec	Peak Displ. cm	Epicent. Dist. km	Mag.	MM I_s	Duration (≥ 0.05 g) sec	Focal Depth km	Type of Fault
J141	San Fernando, CA Lake Hughes Array No. 1	Hard Rock	02/09/71	N 21°E	145.5	18.0	3.4	29.6	6.6	VI	3.54	13	Thrust
L166	San Fernando, CA 3838 Lankershim Blvd., basement, L.A.	Hard Rock	02/09/71	N 00°E S 90°W	164.2 147.6	12.3 15.0	.9 5.4	30.8	6.6	VII	5.42 5.36	13	Thrust
O198	San Fernando, CA Griffith Park Obs., L.A.	Hard Rock	02/09/71	S 90°W	167.0	14.5	5.45	34.0	6.6	VII	8.34	13	Thrust

Note: $980\ cm/sec^2 = 1$ g.

Table 4

Selected Accelerograms;
Cape Ann (Inner Area), Far Field, Hard Site

C.I.T. Catalogue No.	Recording Station	Site Condition	Date	Instr. Comp.	Peak Acc. cm/sec^2 (Scaled value)	Peak Vel. cm/sec (Scaled value)	Epicent. Dist. km (Focal dist.)	Mag.	MM I	Duration a ≥ 0.05 g sec	Pred. Period sec	Focal Depth km	Type of Fault	Scaling Factor
A005	Kern County, CA, Santa Barbara Courthouse	Soft	07/21/52	N 42°E	37.8 (96.6)	11.8 (12.99)	89.5 (90.9)	7.2	VII	13.64	0.64	[illegible]	Thrust	1.1
A0[illegible]	Kern County, CA, Hollywood Storage P. E. Lot.	Soft	07/21/52	S 00°W	53.1 (116.2)	6.6 (13.2)	119.5	7.2	VII		0.71	16	Thrust	2.0
P223	San Fernando, CA, Puddingstone Reservoir, San Dimas	Hard Rock	02/09/71	N 55°E	69.7 (139.4)	4.6 (9.2)	65 (66.3)	6.6	V	0.42	0.41	13	Thrust	2.[illegible]

[illegible] cm/sec^2 = 1 g.

APPENDIX A: EARTHQUAKES IN SOUTHEASTERN NEW ENGLAND, SELECTED FROM CHIBURIS (1981) WITH SUPPLEMENTAL EARTHQUAKES FROM STOVER AND VON HAKE (1980, 1981, AND 1982)

YEAR	MON	DY	TIME*	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1568				41.5	72.5	VI (VII)		CT MOODUS-E.HADDAM
1574				41.5	72.5	V (VII)		CT MOODUS-E.HADDAM
1584				41.5	72.5	V (VII)		CT MOODUS-E.HADDAM
1592				41.5	72.5	V (VII)		CT MOODUS-E.HADDAM
1627				42.6	70.8	VI		MA ESSEX
1638	JUL	01		42.5	70.9	III		MA SALEM
1639	JAN	25		42.5	70.9	III		MA LYNN
1643	MAR	15	1200	42.8	70.8	IV (V)		MA NEWBURY
1643	JUN	11	1800	42.8	70.8	IV		MA NEWBURY
1644	MAR	14		41.9	70.6	II		MA PLYMOUTH
1653	NOV	08		42.6	70.9	IV		MA DANVERS
1658	APR	14		42.5	70.9	V		MA LYNN
1662	FEB	05	2300	41.9	70.6	II		MA PLYMOUTH
1668	APR	03	1400	42.3	71.1	IV		MA BOSTON
1668	JUN	26		42.3	71.1	II		MA ROXBURY
1669	NOV	30		42.3	71.1	II		MA BOSTON
1670				42.3	71.1	II		MA BOSTON
1677	DEC	13		41.1	73.5	IV		CT STAMFORD
1685	FEB	18		42.7	70.8	IV		MA DANVERS
1688	SEP	07		41.7	72.9	II		CT N.BRISTOL
1698				41.4	73.5	IV		CT DANBURY
1701	FEB	10		42.6	70.9	III		MA DANVERS
1701	MAR	08		42.6	70.9	III		MA DANVERS
1702				41.4	73.5	IV		CT DANBURY
1705	JUN	27		42.4	71.1	IV		MA BOSTON
1706				42.3	71.1	II		MA BOSTON
1711				41.4	73.5	IV		CT DANBURY
1721	JAN	19		42.3	71.1	II		MA BOSTON
1724	JUN	23		42.3	71.1	II		MA BOSTON
1727	NOV	10	0340	42.8	70.6	VII (IX)		MA CAPE ANN
1727	NOV	10	0435	42.8	70.6	IV		MA CAPE ANN
1727	NOV	10	0715	42.8	70.6	IV		MA CAPE ANN
1727	NOV	14	2200	42.8	70.6	V (IV)		MA CAPE ANN
1727	NOV	17		42.8	70.6	VIII		MA CAPE ANN
1727	NOV	18	1620	42.8	70.6	IV (V)		MA CAPE ANN
1727	NOV	23	2030	42.8	70.6	II		MA CAPE ANN
1727	NOV	23	2130	42.8	70.6	II		MA CAPE ANN
1727	NOV	24	1000	42.8	70.6	IV		MA CAPE ANN
1727	DEC	01		42.8	70.6	IV		MA CAPE ANN
1727	DEC	16		42.8	70.6	IV		MA CAPE ANN
1727	DEC	19	1500	42.8	70.6	IV		MA CAPE ANN
1727	DEC	29	0330	42.8	70.6	IV (VI)		MA CAPE ANN

* An X in the "time" column denotes that the event was judged to be either an aftershock or foreshock; the geographic location is given as north latitude and west longitude, to the nearest 0.1°. The locations were obtained either instrumentally for the recent events or from the center of maximum intensity for the historical events. Parentheses indicate interpretations of others.

YEAR	MON	DY	TIME	LOCATION LAT.	LOCATION LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1727	DEC	29	0900	42.8	70.6	II		MA CAPE ANN
1728	JAN	05	0300	42.8	70.6	IV (VI)		MA CAPE ANN
1728	JAN	12		43.6	71.7	III		NH NEW HAMPTON
1728	JAN	15	0200	42.8	70.6	III		MA CAPE ANN
1728	JAN	18	0200	42.8	70.6	IV		MA CAPE ANN
1728	FEB	05	0230	42.8	70.6	IV		MA CAPE ANN
1728	FEB	08	1130	42.8	70.6	IV (III)		MA CAPE ANN
1728	FEB	09		42.8	70.6	II		MA CAPE ANN
1728	FEB	10	2030	42.8	70.6	V (VI)		MA CAPE ANN
1728	MAR	03	0530	42.8	70.6	III		MA CAPE ANN
1728	MAR	11		42.8	70.6	III		MA CAPE ANN
1728	MAR	28	0800	42.8	70.6	III		MA CAPE ANN
1728	MAR	31	1840	42.8	70.6	III		MA CAPE ANN
1728	APR	01	0200	42.8	70.6	II		MA CAPE ANN
1728	MAY	09	2200	42.8	70.6	II		MA CAPE ANN
1728	MAY	16		42.8	70.6	IV		MA CAPE ANN
1728	MAY	24	0240	42.8	70.6	IV		MA CAPE ANN
1728	MAY	29	0100	42.8	70.6	IV		MA CAPE ANN
1728	JUN	02	1500	42.8	70.6	IV		MA CAPE ANN
1728	JUN	05	0400	42.8	70.6	III		MA CAPE ANN
1728	JUN	17	0800	42.8	70.6	II		MA CAPE ANN
1728	JUN	19	0800	42.8	70.6	II		MA CAPE ANN
1728	JUN	22	1400	42.8	70.6	II		MA CAPE ANN
1728	JUL	14	0700	42.8	70.6	II		MA CAPE ANN
1728	JUL	30	1500	42.8	70.6	IV		MA CAPE ANN
1728	AUG	02	0315	42.8	70.6	IV		MA CAPE ANN
1728	SEP	25		42.8	70.6	II		MA CAPE ANN
1729	FEB	10	1400	42.8	70.6	V		MA CAPE ANN
1729	MAR	30		41.4	73.5	II		CT DANBURY
1729	MAR	30	1900	42.8	70.6	IV (V)		MA CAPE ANN
1729	AUG	06		41.4	73.5	IV		CT DANBURY
1729	SEP	19	2030	42.8	70.6	IV		MA CAPE ANN
1729	OCT	10	2130	42.8	70.6	IV		MA CAPE ANN
1729	NOV	10	0340	42.8	70.6	III		MA CAPE ANN
1729	NOV	25	1300	42.8	70.6	IV		MA CAPE ANN
1729	DEC	09	0100	42.8	70.6	IV (V)		MA CAPE ANN
1730	FEB	20	0100	42.8	70.6	IV (V)		MA CAPE ANN
1730	FEB	20	0500	42.8	70.6	IV (V)		MA CAPE ANN
1730	MAR	09	1845	42.8	70.6	IV (V)		MA CAPE ANN
1730	APR	24	0100	42.8	70.6	IV		MA CAPE ANN
1730	AUG	08	1400	42.8	70.6	III		MA CAPE ANN
1730	AUG	26	1300	42.8	70.6	III		MA CAPE ANN
1730	NOV	17		42.8	70.6	III		MA CAPE ANN
1730	NOV	25	1400	42.8	70.6	II		MA CAPE ANN
1730	DEC	07	0120	42.8	70.6	IV		MA CAPE ANN
1730	DEC	18	0345	42.8	70.6	III		MA CAPE ANN
1730	DEC	22	2345	42.8	70.6	III		MA CAPE ANN
1730	DEC	24	0330	42.8	70.6	IV (V)		MA CAPE ANN
1731	JAN	13	0000	42.8	70.6	IV		MA CAPE ANN
1731	JAN	19	0000	42.8	70.6	IV		MA CAPE ANN

YEAR	MON	DY	TIME	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1731	JAN	23	0500	42.8	70.6	IV		MA CAPE ANN
1731	MAR	18	2200	42.8	70.6	II		MA CAPE ANN
1731	JUN	06	1400	42.8	70.6	II		MA CAPE ANN
1731	JUL	16	1000	42.8	70.6	IV		MA CAPE ANN
1731	SEP	03	0200	42.8	70.6	II		MA CAPE ANN
1731	OCT	13	0400	42.8	70.6	IV		MA CAPE ANN
1732	FEB	19	0000	42.8	70.6	IV		MA CAPE ANN
1732	SEP	16	1600	45.5	73.6	VIII (IX)		PQ MONTREAL
1732	DEC			42.8	70.6	III		MA CAPE ANN
1733	JAN	10	A.M.	42.8	70.6	III		MA CAPE ANN
1733	MAR	12		42.8	70.6	II		MA CAPE ANN
1733	OCT	10		42.8	70.6	II		MA CAPE ANN
1733	OCT	30	P.M.	42.8	70.6	II		MA CAPE ANN
1734	JUN	28	0320	42.8	70.6	II		MA CAPE ANN
1734	JUL	10	2015	42.8	70.6	II		MA CAPE ANN
1734	OCT	20	1520	42.8	70.6	III		MA CAPE ANN
1734	NOV	23	0500	42.8	70.6	IV (V)		MA CAPE ANN
1734	NOV	27	1100	42.8	70.6	III		MA CAPE ANN
1736	FEB	13	2245	42.8	70.6	IV		MA CAPE ANN
1736	APR	01	1530	42.8	70.6	II		MA CAPE ANN
1736	JUL	24	1445	42.8	70.6	III		MA CAPE ANN
1736	OCT	12	0630	42.8	70.6	IV		MA CAPE ANN
1736	NOV	23	0700	42.8	70.6	IV (II)		MA CAPE ANN
1736	NOV	23	1100	42.8	70.6	III		MA CAPE ANN
1737	FEB	17	2115	42.8	70.6	IV		MA CAPE ANN
1737	SEP	20	1520	42.8	70.6	IV (V)		MA CAPE ANN
1737	DEC	19	0330	40.8	74.0	VII (VIII)		NY NY CITY
1739	AUG	13	0730	42.8	70.6	IV (V)		MA CAPE ANN
1740	DEC	25	1135	42.8	70.6	II		MA CAPE ANN
1741	JAN	29	0900	42.8	70.6	II		MA CAPE ANN
1741	FEB	05	2050	42.8	70.6	IV		MA CAPE ANN
1741	JUN	24	1535	42.2	71.2	III (V)		MA BOSTON
1741	DEC	17	1300	42.3	71.2	IV		MA BOSTON
1744	JUN	13		42.3	71.2	II		MA CAMBRIDGE
1744	JUN	14		42.6	70.9	II		MA CAPE ANN
1744	JUN	14		42.6	70.9	II		MA CAPE ANN
1744	JUN	14	1515	42.5	70.9	VI (VII)		MA CAPE ANN
1744	JUN	14	2200	42.5	70.9	IV (V)		MA SALEM
1744	JUN	15		42.6	70.9	II		MA CAPE ANN
1744	JUL	01		42.5	70.9	IV (V)		MA SALEM
1744	JUL	09		42.5	70.9	III		MA SALEM
1744	DEC	23	1700	42.8	70.6	II		MA CAPE ANN
1745	JAN	03	1700	42.8	70.9	III		MA NEWBURY
1745	JUN	12		42.3	71.1	II		MA BOSTON
1746	FEB	03	0200	42.3	71.1	II		MA BOSTON
1746	FEB	14	0200	42.3	71.1	III		MA BOSTON
1747	AUG	25	A.M.	43.2	70.9	III		NH DOVER
1751	JUL	21	A.M.	43.2	70.9	III		NH DOVER
1755	NOV	18	0912	42.7	70.3	VIII (IX)		MA OFF CAPE AANN
1755	NOV	18	1029X	42.7	70.3	IV		MA OFF CAPE ANN

YEAR	MON	DY	TIME	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1755	NOV	23	0127X	42.7	70.3	V (VI)		MA OFF CAPE ANN
1755	DEC	20	0115X	42.7	70.3	IV (III)		MA OFF CAPE ANN
1756	JAN	02		42.3	71.1	III		MA BOSTON
1756	NOV	16	0900X	42.3	71.1	III		MA BOSTON
1756	DEC	05	0300	42.3	71.1	III		MA BOSTON
1757	JUL	08	1915	42.3	71.1	IV (III)		MA BOSTON
1759	FEB	02	0700	42.3	71.0	IV		MA BOSTON
1760	FEB	03		42.3	71.1	II		MA BOSTON
1760	NOV	09		42.3	71.1	III		MA BOSTON
1761	FEB			42.3	71.1	III		MA BOSTON
1761	MAR	12	0715	42.5	70.9	V		MA BOSTON
1761	MAR	16		42.3	71.1	IV		MA BOSTON
1761	NOV	02	0100	43.1	71.5	IV (V)		NH S. OF CONCORD
1766	JAN	23	1000X	43.7	70.3	IV (V)		ME PORTLAND
1766	JAN	24	X	43.7	70.3	II		ME PORTLAND
1766	JUN	14		42.7	70.9	III		MA ESSEX
1766	AUG	25		41.5	71.3	IV (V)		RI NEWPORT
1766	DEC	17	1148	43.1	70.8	IV		NH PORTSMOUTH
1769	OCT	19	A.M.	43.7	70.3	IV		ME PORTLAND
1769	OCT	19	1700X	43.7	70.3	IV		ME PORTLAND
1772	AUG	15		44.4	71.1	II		NH SHELBURNE
1776	FEB	07		41.7	71.4	II		RI SOUTHERN
1777	SEP	14		43.0	71.5	II		NH MANCHESTER
1780	NOV	29		42.5	70.9	IV		MA LYNN
1783	NOV	24		41.0	74.5	IV		NJ MORRIS CO.
1783	NOV	30	0200	41.0	74.5	IV		NJ MORRIS CO.
1783	NOV	30	0350	41.0	74.5	VI (V)		NJ MORRIS CO.
1783	NOV	30	0700	41.0	74.5	IV		NJ MORRIS CO.
1786	NOV	29	2100	42.4	71.1	III		MA CAMBRIDGE
1787	FEB	25	0600	42.4	71.1	III		MA CAMBRIDGE
1791	MAY	16	1300	41.5	72.5	VI (VIII)		CT MOODUS-E.HADDAM
1791	MAY	19	0300X	41.5	72.5	IV		CT MOODUS-E.HADDAM
1792	JAN	10		42.5	70.9	II		MA SALEM
1792	AUG	29	0300	41.5	72.5	IV		CT MOODUS-E.HADDAM
1792	OCT	24	0600	41.5	72.5	IV		CT MOODUS-E.HADDAM
1793	JAN	11	1300X	41.5	72.5	IV		CT MOODUS-E.HADDAM
1793	JUL	06	1100X	41.5	72.5	IV		CT MOODUS-E.HADDAM
1794	MAR	06	1900X	41.5	72.5	IV		CT MOODUS-E.HADDAM
1794	MAR	07	0400X	41.5	72.5	IV		CT MOODUS-E.HADDAM
1794	MAR	09	1900X	41.5	72.5	IV		CT MOODUS-E.HADDAM
1794	MAR	10	0400X	41.5	72.5	IV		CT MOODUS-E.HADDAM
1800	NOV	11		42.3	71.1	III		MA BOSTON
1800	DEC	20		43.7	72.3	IV		NH NW OF NEWPORT
1800	DEC	25		41.9	71.1	IV (VI)		NA WAREHAM-TAUNTON
1801	MAR	01	2030	43.1	70.8	IV		NH FORTSMOUTH
1803	JAN	18	1450	42.5	70.9	IV		MA SALEM
1804	FEB	08		42.5	70.9	II		MA SALEM
1804	MAY	18		40.8	74.0	III		NY NY CITY
1805	APR	06	1915	42.5	70.9	IV		MA LYNN
1805	APR	25		42.5	70.9	IV		MA SALEM

YEAR	MON	DY	TIME	LOCATION LAT.	LOCATION LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1805	MAY	12		42.8	70.8	II		MA NEWBURY
1805	AUG	12	0000	41.5	72.5	III (IV)		CT MOODUS-E.HADDAM
1805	DEC	30	1100	41.5	72.5	III (IV)		CT MOODUS-E.HADDAM
1807	JAN	12		42.3	72.6	II		MA NORTHAMPTON
1807	JAN	14	0400	43.0	71.1	IV		NH NEAR EXETER
1807	FEB	22	1900	43.7	70.5	III		ME WINDHAM
1807	MAY	06	1800	43.5	70.5	IV		ME SACO RIVER
1810	NOV	10	0215	43.0	70.8	V (VI)		NH PORTSMOUTH
1811	JUL			41.5	72.5	III		CT MOODUS-E.HADDAM
1812	FEB	09	1400	41.5	72.5	III		CT MOODUS-E.HADDAM
1812	JUL	05	1300	41.5	72.5	III		CT MOODUS-E.HADDAM
1813	DEC	28	2100	41.5	72.5	III (IV)		CT MOODUS-E.HADDAM
1814	NOV	29	0014	43.7	70.3	V (IV)		ME WINDHAM
1817	SEP	07		42.5	70.9	III		MA LYNN
1817	OCT	05	1645	42.5	71.2	VI (V)		MA WOBURN
1823	JUL	23	1155	42.9	70.6	V (IV)		NH OFF HAMPTON
1827	AUG	23		41.4	72.7	IV (V)		CT NW OF NEW LONDON
1829	JAN	01		43.1	70.8	IV		NH PORTSMOUTH
1830	DEC	02	0100	42.5	70.9	III		MA LYNN
1837	JAN	15	0700	42.5	70.9	IV		MA LYNN
1837	APR	12		41.7	72.7	V (IV)		CT HARTFORD
1840	AUG	09	2030	41.5	72.9	V (IV)		CT HARTFORD
1843	MAR	14		44.4	72.5	IV		VT N. OF MONTPELIER
1843	OCT	24		41.1	71.2	IV		MA CANTON
1844	JUN		0100	41.5	72.4	III		CT MOODUS-E.HADDAM
1845	JAN	01		41.5	72.4	III		CT MOODUS-E.HADDAM
1845	OCT	26	2315	41.2	73.3	V (VI)		CT BRIDGEPORT
1845	NOV			43.6	72.3	IV		NH LEBANON
1846	MAY	30	1830	42.7	70.3	IV		MA CAPE ANN
1846	JUL	10		43.1	71.3	III		NH DEERFIELD
1846	AUG	25	0945	42.5	70.8	V (IV)		MA MARBLEHEAD
1846	SEP	12	2330	43.1	71.3	III		NH DEERFIELD
1846	OCT	30	0200	43.1	71.3	III		NH DEERFIELD
1846	OCT	31	P.M.X	43.1	71.3	III		NH DEERFIELD
1846	NOV	13	0040X	43.1	71.3	III		NH DEERFIELD
1846	DEC	02		43.1	71.3	III		NH DEERFIELD
1847	JAN	12	0430	42.6	73.7	II		NY ALBANY
1847	FEB	02		43.1	71.3	III		NH DEERFIELD
1847	FEB	14		43.1	71.3	III		NH DEERFIELD
1847	FEB	21		43.1	71.3	III		NH DEERFIELD
1847	APR	02	0200	43.7	70.7	III		ME LIMINGTON
1847	JUL	09	A.M.	43.3	73.7	III		NY GLENS FALLS
1847	AUG	08	1500	41.7	70.1	VI (V)		MA BREWSTER
1849	FEB	04		41.5	71.6	III		RI NEWPORT
1849	FEB	15		42.1	72.6	III		MA SPRINGFIELD
1849	OCT	08	P.M.	42.5	71.4	IV		MA MIDDLESEX CO.
1851	OCT	12	0230	43.1	71.3	III		NH DEERFIELD
1851	DEC	25	1245	44.0	73.3	III		VT BRIDGEPORT
1852	JAN	10	1140	41.2	71.4	IV		RI OFF COAST
1852	JUN	30		43.4	72.3	III		NH CLAREMONT

YEAR	MON	DY	TIME	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1852	AUG	01		41.4	72.1	III		CT GROTON
1852	AUG	11	P.M.	43.1	71.3	III		NH DEERFIELD
1852	NOV	28	0445	43.0	70.9	V (IV)		NH EXETER
1853	AUG	17		41.6	70.9	III		MA NEW BEDFORD
1853	SEP	08	0410	41.6	70.9	III		MA NEW BEDFORD
1853	NOV	21		43.0	71.9	III		NH ANTRIM
1853	NOV	28		43.0	71.9	IV		NH ANTRIM
1854	JAN	24	1200	42.2	72.3	III		MA PALMER
1854	JAN	27	1200	42.2	72.3	III		MA PALMER
1854	FEB	23	0500	42.5	71.1	III		MA READING
1854	OCT	01		42.9	72.3	II		NH KEENE
1854	OCT	25	0300	42.9	72.3	IV		NH KEENE
1854	DEC	11	1530	43.0	70.8	V (IV)		NH NORTH HAMPTON
1855	JAN	16	2300	44.0	71.0	V (IV)		ME OTISFIELD
1855	JAN	17	0020	44.0	71.0	IV		ME OTISFIELD
1855	JAN	23	2000	42.6	70.4	III		MA NEWBURY
1855	FEB	07	0430	42.0	74.0	VI		NY HUDSON VALLEY
1855	DEC	17	1900	43.3	73.7	IV		NY WARREN
1856	MAR	13	0300	41.4	72.6	IV		CT HADDAM
1856	JUN	10		43.1	72.5	II		VT BELLOWS FALLS
1857	JUL	01	0345	41.5	72.5	IV (III)		CT MOODUS-E.HADDAM
1858	JUN	27		41.4	72.8	IV		CT NORTH HAVEN
1858	JUL	01	0345	41.3	73.0	IV (V)		CT NEW HAVEN
1860	MAR	12	A.M.	41.5	72.5	III		CT MOODUS-E.HADDAM
1860	MAR	17	0230	42.2	70.5	IV (V)		MA OFF PROVINCETOWN
1860	MAR	17	0315X	42.4	70.5	IV (V)		MA OFF PROVINCETOWN
1861	MAR	01		42.4	71.1	III		MA BOSTON
1862	FEB	03	0100	41.5	72.5	IV		CT MOODUS-E.HADDAM
1862	FEB	04	1230	42.5	71.2	III		MA CAMBRIDGE
1870	OCT	23	1130	42.1	72.6	III		MA SPRINGFIELD
1871	JUL	20		43.2	71.5	IV		NH CONCORD
1872	NOV	18	1900	43.2	71.6	V (IV)		NH CONCORD
1873	JUL	16	A.M.	42.3	71.8	II		MA WORCESTER
1873	OCT	05	0730	42.9	71.3	III		NH DERBY
1874	JAN	06		43.6	71.2	IV		NH WOLFEBORO
1874	JAN	25	1700	42.6	71.4	IV		MA LOWELL
1874	JAN	26	0700	43.0	71.5	IV		NH MANCHESTER
1874	JAN	26	1000	43.0	71.5	III		NH MANCHESTER
1874	FEB	12	1130	43.5	70.5	II		ME SACO
1874	NOV	24		42.7	70.9	IV		MA SALEM-NEWBURY
1875	FEB	09		41.5	72.0	II		CT PRESTON
1875	MAY	06		43.6	71.2	II		NH WOLFEBORO
1875	MAY	15	1515	42.4	71.1	II		MA CAMBRIDGE
1875	JUL	28	0910	41.9	73.0	V		CT NW OF TORRINGTON
1875	SEP	26	0200	41.3	73.3	II		CT STEPNEY
1875	NOV	01	0218	42.4	71.1	II		MA CAMBRIDGE
1875	DEC	01	0900	42.9	72.3	IV		NH KEENE
1875	DEC	01	1100	42.9	72.3	II		NH KEENE
1876	JAN	07		43.3	71.7	II		NH WARNER & CONTOOCOOK
1876	SEP	22	0430	41.5	71.3	V (IV)		RI NEWPORT

YEAR	MON	DY	TIME	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1877	APR	23	1600	43.0	71.3	II		NH AUBURN
1877	MAY	14	P.M.	42.8	73.9	II		NY SCHENECTADY
1877	SEP	10	0700	42.4	71.1	III		MA CAMBRIDGE
1878	MAR	12		42.7	71.6	II		VT MILFORD
1878	OCT	04	0730	41.5	74.0	V		NY HUDSON VALLEY
1878	DEC	29	0232	42.7	74.3	III		NY SCHOHARIE
1879	OCT	24	2312	41.3	72.9	II		CT NEW HAVEN
1879	OCT	26	0330	43.0	71.5	IV		NH MANCHESTER
1879	NOV	03	1215	43.2	71.7	II		NH CONTOOCOOK
1880	MAR	29		43.4	70.7	III		ME SANFORD
1880	MAY	12	1245	42.7	71.0	V (IV)		MA BOXFORD
1880	JUL	13	0400	43.2	71.6	II		NH CONCORD
1880	JUL	21	0000	43.0	71.5	III		NH MANCHESTER
1880	AUG	21		43.2	71.1	II		NH BARRINGTON
1880	SEP	23	2300	44.3	73.3	II		VT CHARLOTTE
1881	FEB	02	0900	42.3	71.1	II		MA BOSTON
1881	FEB	03	0900	42.0	70.7	II		MA PLYMOUTH
1881	FEB	04		43.0	70.8	II		NH GREENLAND
1881	FEB	12		43.0	70.8	II		NH PORTSMOUTH
1881	MAR	19	0230	42.8	73.9	III		NY SCHENECTADY
1881	APR	03	0925	43.0	71.9	III		NH ANTRIM
1881	APR	21	1630	40.9	73.1	III		NY PORT JEFFERSON
1881	MAY	18	0520	43.2	71.7	III		NH CONTOOCOOK
1881	MAY	18	0830	43.2	71.7	III		NH CONTOOCOOK
1881	JUN	19	0825	42.8	70.9	IV		MA NEWBURY
1881	AUG	13	A.M.	43.2	71.7	III		NH CONTOOCOOK
1881	OCT	06	0503	43.2	71.6	IV (III)		NH BRISTOL
1881	OCT	31	0640	43.2	71.7	IV (II)		NH CONTOOCOOK
1881	DEC	16	2100	42.3	71.1	III		MA DORCHESTER
1882	APR	02	A.M.	43.0	74.3	II		NY AMSTERDAM
1882	APR	17	1900	43.2	71.7	IV		NH HOPKINTON
1882	MAY	01		41.6	71.4	II		RI E.GREENWICH
1882	MAY	08	0900	43.2	71.6	III		NH CONCORD
1882	DEC	19	2224	43.2	71.4	V (IV)		NH CONCORD
1883	FEB	04	2005	43.6	71.2	IV (II)		NH WOLFEBORO
1883	FEB	28	0330	41.5	71.3	V		RI NEWPORT
1884	JAN	18	0700	43.2	71.7	IV		NH CONTOOCOOK
1884	AUG	08		41.3	70.2	II		MA NANTUCKET I.
1884	OCT	10	A.M.	42.3	71.1	II		MA ROXBURY
1884	OCT	27	0100	42.8	71.4	II		NH NASHUA
1884	NOV	13	0050	43.2	71.6	IV (II)		NH CONCORD
1884	NOV	23	1730	43.2	71.7	V (VI)		NH CONCORD
1884	DEC	04	0518	42.3	72.7	II		MA NORTHAMPTON
1884	DEC	17	0700	43.7	71.5	IV (III)		NH CENTER HARBOR
1885	JAN	03	0700	43.5	71.5	II		NH LACONIA
1885	JAN	04	1106	41.3	73.9	III		NY PEEKSKILL
1885	JAN	31	1005	41.3	73.8	III		NY YORKTOWN
1885	MAR	18	1700	43.2	71.7	II		NH CONTOOCOOK
1885	APR	28	2210	41.3	72.7	III		CT GUILFORD
1886	JAN	06	0010	42.9	71.5	IV		NH MERRIMACK

YEAR	MON	DY	TIME	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1886	JAN	09		41.9	73.1	II		CT WINSTED
1886	JAN	17	2214	42.8	71.4	IV		NH NASHUA
1886	JAN	25		41.6	73.8	IV		NY HOPEWELL JCT
1886	FEB	03		41.2	73.2	II		CT BRIDGEPORT
1886	AUG	03		43.5	71.5	II		NH MAYFIELD
1886	AUG	03		44.3	71.7	II		NH BETHLEHEM
1886	SEP	03		42.5	73.4	II		NY LEBANON SPRINGS
1886	SEP	05		41.5	72.5	IV		CT MOODUS-E.HADDAM
1886	SEP	09		42.5	73.4	II		NY LEBANON SPRINGS
1887	JUL	01	0200	43.2	71.5	IV		NH CONCORD
1888	JAN	18		43.2	71.7	II		NH CONTOOCOOK
1888	JAN	30		41.7	71.2	II		MA FALL RIVER
1889	MAR	08		43.5	71.6	IV		NH FRANKLIN
1889	APR	11		43.0	71.5	II		NH MANCHESTER
1889	AUG	10		43.4	73.7	IV		NY LAKE GEORGE
1890	MAR	29		43.2	71.5	II		NH CONCORD
1891	JAN	15		42.6	71.8	II		MA FITCHBURG
1891	MAY	02	0010	43.2	71.6	V		NH NEAR CONCORD
1891	MAY	30	0000	43.1	71.5	IV		NH NEAR CONCORD
1892	MAY	01		43.2	71.5	II		NH CONCORD
1892	DEC	11	1630	44.3	71.7	IV		NH BETHLEHEM
1892	DEC	13	X	44.5	71.5	II		NH LANCASTER
1892	DEC	14		44.3	71.7	II		NH BETHLEHEM
1893	MAR	14		42.3	72.7	IV		MA LEEDS
1893	JUN	25		41.9	70.9	II		MA MIDDLEBORO
1893	JUL	01		43.1	71.9	II		NH ANTRIM
1893	JUL	02		42.9	72.1	II		NH DUBLIN
1893	AUG	02		41.7	70.9	II		MA NEW BEDFORD
1894	APR	10	A.M.	41.6	72.5	IV		CT MOODUS-E.HADDAM
1894	SEP	03		43.2	72.4	II		NH ALSTEAD
1894	NOV	23	1230	41.4	72.1	III		CT NEW LONDON
1894	DEC	17		42.5	73.8	IV		NY S. OF ALBANY
1895	MAY	28	1615	43.0	72.5	III		VT PUTNEY
1896	OCT	22	1030	44.3	71.8	IV		NH BETHLEHEM
1897	JUL	01	0920	43.7	71.6	IV		NH MEREDITH
1897	SEP	05		41.5	72.5	IV		CT MOODUS-E.HADDAM
1898	JUN	11	0645	42.8	72.6	IV		VT BRATTLEBORO-VERNON
1898	JUL	25		43.3	71.6	II		NH CONCORD-CANTERBURY
1899	MAY	17	0115	41.6	72.6	V (IV)		CT MOODUS-E.HADDAM
1900	APR	03		41.7	70.9	II		MA NEW BEDFORD
1900	DEC	31		44.3	72.6	II		VT MONTPELIER
1901	MAR	09		43.2	71.5	II		NH CONCORD
1902	JUL	19		43.6	71.9	II		NH GRAFTON
1903	JAN	21	A.M.	42.1	70.9	V		MA WHITMAN
1903	JAN	22		42.0	71.3	IV		MA ATTLEBORO
1903	APR	24	1230	42.7	71.0	IV (V)		MA MERRIMAC VALLEY
1905	FEB	05		42.8	70.8	II		MA NEWBURY
1905	MAR	05	0225	43.6	72.3	V (IV)		NH LEBANON
1905	MAY	27		44.3	72.6	II		VT MONTPELIER
1905	AUG	30	1040	43.1	70.7	V (IV)		NH ROCKINGHAM CO.

YEAR	MON	DY	TIME	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1905	NOV	26	0030	41.5	71.3	IV		RI NEWPORT
1906	MAY	08	1330	41.5	72.5	IV		CT MOODUS-E.HADDAM
1906	MAY	14		41.2	73.2	II		CT BRIDGEPORT
1906	OCT	19	P.M.X	43.5	70.5	III		ME SACO
1906	OCT	20	1415	43.5	70.5	IV (V)		ME SACO
1907	JAN	24	1130	42.8	74.0	IV (V)		NY SCHENECTADY
1907	JUN	29		43.5	70.5	IV (III)		ME BIDDEFORD
1907	JUL	11		43.1	70.8	II		ME NE-NH COAST
1907	OCT	16	0010	42.8	71.0	V		MA NEWBURY
1908	FEB	05	0700	42.3	71.2	III		MA NEEDHAM
1908	FEB	05	0820	41.4	73.2	IV		CT HOUSATONIC VALLEY
1908	NOV	23	1300	43.5	71.7	IV		NH FRANKLIN
1909	AUG	16	0130	42.3	71.2	III		MA NEEDHAM
1910	AUG	21	1845	42.7	71.1	IV		MA MERRIMAC VALLEY
1910	AUG	30	1430	43.4	72.1	IV		NH LAKE SUNAPEO
1911	FEB	06	1136	42.4	71.1	II		MA CAMBRIDGE
1911	MAR	02	2130	43.2	71.5	IV		NH CONCORD
1913	MAR	31	1600	42.3	71.8	II		MA WORCESTER
1913	NOV	03	1430	41.5	71.5	IV (V)		RI KINGSTOWN
1913	NOV	15		41.5	72.5	III		CT MOODUS-E.HADDAM
1914	JAN	14	0000	42.3	71.2	III		MA NEEDHAM
1915	FEB	21	0203	42.8	71.1	IV (V)		MA MERRIMAC VALLEY
1916	JAN	05	1356	43.7	73.7	V (IV)		NY LAKE GEORGE
1916	FEB	02	1626	42.9	74.0	V (IV)		NY MOHAWK VALLEY
1916	FEB	03	0420	43.0	74.0	V		NY MOHAWK VALLEY
1916	JUN	08	2115	41.0	73.8	IV (V)		NY WESTCHESTER CO.
1916	NOV	02	0232	43.3	73.7	V		NY GLENS FALLS
1916	DEC	02	0900	41.5	72.5	III		CT MOODUS-E.HADDAM
1917	FEB	16	0900	41.5	72.5	IV		CT MOODUS-E.HADDAM
1917	MAR	11		41.5	72.5	III		CT MOODUS-E.HADDAM
1917	OCT	02	0214	43.3	73.6	III		NY GLENS FALLS
1919	AUG	11		41.5	72.5	III		CT MOODUS-E.HADDAM
1920	MAY	23	0800	43.1	71.5	IV		NH CONCORD
1920	JUN	07	0800	43.5	70.5	IV		ME SACO
1921	JAN	19	1000	43.3	73.7	IV		NY GLENS FALLS
1921	JAN	27	A.M.	43.3	73.7	IV		NY GLENS FALLS
1921	JUL	29	2114	42.5	70.4	IV		MA CAMBRIDGE
1922	MAY	07	2240	43.4	71.4	IV		NH PITTSFIELD
1923				42.8	71.0	II		MA GROVELAND
1925	JAN	07	1307	42.6	70.6	V		MA CAPE ANN
1925	MAR	09		42.9	71.5	IV		NH GOFF'S FALLS
1925	APR	24	0756	41.7	70.8	V (IV)		MA WAREHAM
1925	MAY	04	1751	42.5	70.9	IV		MA LYNN
1925	OCT	09	1355	43.7	71.1	VI		NH OSSIPEE
1925	OCT	24	0130	41.4	73.3	III		CT NEWTOWN
1925	OCT	30	A.M.	41.5	72.5	IV		CT MOODUS-E.HADDAM
1925	NOV	01	X	41.5	72.5	II		CT MOODUS-E.HADDAM
1925	NOV	14	1304	41.7	72.4	V (VI)		CT N. OF HEBRON
1925	NOV	16	0620	41.8	72.7	IV		CT HARTFORD
1925	NOV	22	0600	41.8	71.3	III		MA FALL RIVER

YEAR	MON	DY	TIME	LOCATION LAT.	LOCATION LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1926	JAN	04		41.6	71.8	IV		CT VOLUNTOWN
1926	JAN	22	1957	42.4	71.1	II (III)		MA CAMBRIDGE
1926	MAR	04	2100	42.5	70.9	II		MA LYNN
1926	MAR	18	2109	42.8	71.8	V (VI)		NH NEW IPSWITCH
1926	MAY	22		41.7	73.9	II		NY POUGHKEEPSIE
1926	OCT	25	0152	42.1	71.0	III		MA BROCKTON
1927	MAR	09	0408	43.3	71.4	IV (V)		NH CONCORD
1927	MAR	30	P.M.	41.7	72.8	IV		CT NEW BRITAIN
1927	AUG	20		42.3	71.0	IV		MA QUINCY
1928	JAN	13	1950	41.2	71.6	IV (V)		RI BLOCK I.
1928	APR	28	2207	43.2	71.5	IV		NH CONCORD
1928	MAY	22	0024	43.2	71.5	II		NH CONCORD
1928	MAY	26		43.2	71.7	II		NH CONTOOCOOK
1928	OCT	17	0030	42.8	71.6	III		NH WILTON
1928	NOV	05	0400	43.3	71.0	II		NH ROCHESTER
1928	DEC	01		43.3	71.0	II		NH ROCHESTER
1928	DEC	08	0412	41.8	72.5	II		CT ELLINGTON
1929	JAN	13		43.3	71.0	II		NH ROCHESTER
1929	JAN	15	0245	43.3	71.0	III		NH ROCHESTER
1929	FEB	05	1710	43.3	71.7	II		NH WEARE
1929	SEP	17	0445	42.2	71.0	II		MA HOLBROOK
1930	FEB	14	0615	43.4	71.7	IV (III)		NH FRANKLIN
1930	MAR	19	0015	43.3	71.6	IV		NH CONCORD
1930	MAR	27	1930	42.1	72.7	III		MA W.SPRINGFIELD
1930	AUG	01	0200	41.5	70.8	III		MA NEW BEDFORD
1931	APR	20	1954	43.4	73.7	VII	5.0	NY LAKE GEORGE
1931	MAY	04	1017	42.4	72.5	III		MA AMHERST
1931	JUL	01	0245	41.6	73.4	IV		CT NEW MILFORD
1932	JUL	20	2330	42.2	73.2	II		MA LAKE GARFIELD
1932	OCT	15	0310	43.6	71.5	III		NH MEREDITH
1932	OCT	16	1912	42.9	72.3	II		NH KEENE
1932	NOV	04	0500	43.2	71.5	II		NH CONCORD
1933	JAN	17	0530	41.6	70.9	IV (III)		MA NEW BEDFORD
1933	JUN	26	1410	41.0	73.8	III		NY SCARSDALE
1934	JAN	30	1030	41.8	72.6	IV		CT S.WINDSOR
1934	APR	11	0300	44.0	72.7	III		VT RUTLAND-MONTPELIER
1934	APR	11	0324	44.0	72.7	III		VT RUTLAND-MONTPELIER
1934	AUG	02	1458	42.6	70.7	IV		MA CAPE ANN
1935	JAN	30	2020	42.6	71.3	II		MA BILLERICA
1935	APR	24	0124	42.2	70.2	IV		MA OFF CAPE COD
1935	AUG	09	0730	41.4	72.1	II		CT NEW LONDON
1935	SEP	13	0349	43.2	71.5	III (II)		NH CONCORD
1935	NOV	01	0630	44.3	72.6	II		VT MONTPELIER
1935	NOV	01	0630	42.6	74.6	II		NY RICHMONDVILLE
1936	JUN	14	0540	43.5	71.5	III		NH LACONIA
1936	JUN	15		43.8	71.4	III		NH CENTER SANDWICH
1936	NOV	10	0246	43.6	71.4	V		NH LACONIA
1937	JUL	27	0910	41.8	72.4	IV		CT MANCHESTER
1937	OCT	11	2200	41.2	73.8	II		NY WESTCHESTER CO.
1937	OCT	12	0100	41.2	73.8	II		NY WESTCHESTER CO.

YEAR	MON	DY	TIME	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1937	OCT	12	0600	43.3	70.5	II		ME KENNEBUNKPORT
1938	APR	01	2215	43.3	71.0	III		NH ROCHESTER
1938	APR	02	0213	43.3	71.0	III		NH ROCHESTER
1938	APR	03		43.3	71.0	II		NH ROCHESTER
1938	APR	13	0100	43.2	73.1	II		VT MANCHESTER
1938	JUN	14	0402	41.4	73.4	II		CT BETHEL
1938	JUN	14	1930	41.4	73.4	I (II)		CT BETHEL
1938	JUN	23	0357	42.6	71.4	IV		MA CHELMSFORD
1938	JUL	29	0744	41.0	73.7	III		NY WESTCHESTER CO.
1938	AUG	02	0902	41.1	73.7	IV (III)		CT GREENWICH
1938	AUG	23	0518	41.2	73.7	III		NY WESTCHESTER CO.
1938	AUG	23	0711	41.2	73.7	III		NY WESTCHESTER CO.
1938	SEP	20		41.5	72.2	III		CT NORWICH
1938	OCT	21	0718	41.2	73.7	II		NY DUTCHESS CO.
1939	FEB	01	1037	42.6	71.4	II		MA CHELMSFORD
1939	AUG	12		41.5	72.5	II		CT MOODUS-E.HADDAM
1939	SEP	21	2030	41.4	74.1	II		NY ORANGE CO.
1939	OCT	10	A.M.	43.4	71.6	III		NH TILTON
1939	OCT	11	1849	42.9	71.4	III		NH DERRY
1939	OCT	21	0859	43.3	73.3	II		NY GLENS FALLS
1939	OCT	25	1446	42.2	73.9	II		NY HUDSON
1940	JAN	02	0205	42.5	71.5	III		MA LITTLETON
1940	JAN	03	0130	41.2	71.6	II		RI BLOCK ISLAND
1940	JAN	28	2311	41.6	70.8	V (IV)		MA BUZZARDS BAY
1940	MAR	02	0415	41.5	72.5	III (IV)		CT MOODUS-E.HADDAM
1940	MAR	13	0129	41.5	72.5	III		CT MOODUS-E.HADDAM
1940	APR	12	0158	42.8	74.6	II		NY SE OF ST.JOHNSVILLE
1940	DEC	20	0727	43.8	71.3	VII	5.8	NH OSSIPEE
1940	DEC	24	1300	43.8	71.3	II		NH OSSIPEE
1940	DEC	24	1343	43.8	71.3	VII	5.8	NH OSSIPEE
1940	DEC	24	1432	43.8	71.3	III		NH OSSIPEE
1940	DEC	24	1812	43.8	71.3	III		NH OSSIPEE
1940	DEC	25	0503	43.8	71.3	IV	4.0	NH OSSIPEE
1940	DEC	27	1956	43.8	71.3	IV	3.9	NH OSSIPEE
1941	JAN	02	0342	43.8	71.3	III		NH OSSIPEE
1941	JAN	04	1110	43.8	71.3	III		NH OSSIPEE
1941	JAN	18	2325	43.8	71.3	III		NH OSSIPEE
1941	JAN	21	0227	43.8	71.3	IV	3.6	NH OSSIPEE
1941	JAN	23	0014	43.8	71.3	III		NH OSSIPEE
1941	FEB	12	2223X	43.8	71.3	III		NH OSSIPEE
1941	MAY	19	1159	43.8	72.3		2.0	VT N.OF HANOVER NH
1941	JUL	29	0024	41.1	73.8	III		NY WHITE PLAINS
1941	OCT	11	0815	42.3	72.3	IV	3.0	MA STURBRIDGE
1942	APR	23	2040	41.4	72.9		2.0	CT NEW HAVEN
1942	JUN	14	1104	42.4	70.7	II		MA OFF BOSTON
1942	JUN	14	1630	42.4	70.7	II		MA OFF BOSTON
1942	JUN	14	1952	42.7	70.7	II		MA OFF BOSTON
1942	OCT	01	2058	44.0	73.6		2.5	NY LAKE CHAMPLAIN
1942	OCT	02	2229	42.6	73.8		3.0	NY ALBANY
1942	DEC	09	1800	41.8	72.7	II		CT HARTFORD

YEAR	MON	DY	TIME	LOCATION LAT.	LOCATION LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1943	MAR	14	1402	43.7	71.6		3.9	NH MEREDITH
1943	MAR	31	1130	42.3	72.6	II		MA NORTHAMPTON
1943	JUN	11	2251	41.1	71.8	II		RI BLOCK ISLAND SOUND
1944	MAR	06	0546	43.2	71.6	II		NH CONCORD
1944	MAR	06	1215	43.2	71.6	II		NH CONCORD
1944	APR	11	2025	44.0	71.7	III		NH WOODSTOCK
1944	JUN	04	0208	44.2	72.8	III		VT NORTHFIELD
1944	DEC	14	0314	41.6	72.8	IV		CT MERIDEN
1945	MAR	22	0803	43.2	71.6	III		NH CONCORD
1945	AUG	05	1720	43.6	72.5	III		VT WOODSTOCK
1945	DEC	28	1023	43.8	71.3	II		NH S.TAMWORTH
1946	NOV	28	2200	43.9	73.8	III		NY SCHROON LAKE
1947	JAN	04	1851	41.0	73.6	IV (V)		CT GREENWICH
1947	APR	01	1325	41.0	74.3	III		NJ POMPTON LAKES
1948	APR	04	0244	44.2	73.6		2.5	NY E.OF LAKE PLACID
1948	MAY	04	0223	41.4	71.8	IV		RI WESTERLY
1948	JUN	04	0900	41.3	72.5	III (II)		CT WESTBROOK
1949	APR	17	0015	41.6	71.5	IV		RI N.KINGSTON
1949	SEP	02	0548	43.8	71.3	III		NH S.TAMWORTH
1950	FEB	24	1304	43.0	71.8	III		NH SW OF CONCORD
1950	MAR	29	1443	41.0	73.6	IV		CT GREENWICH
1951	JAN	26	0327	41.5	72.5	IV		CT MOODUS-E.HADDAM
1951	MAR	31	0350	42.2	72.2	IV		MA PALMER
1951	JUN	10	1720	41.5	71.5	IV	4.6	RI KINGSTOWN
1951	SEP	03	2126	41.2	74.3	V	4.4	NY ROCKLAND CO.
1951	SEP	21	1723	41.3	70.1	II (III)		MA NANTUCKET
1951	DEC	08	0437	41.6	73.8	II (III)		NY NEWBURGH
1952	OCT	08	2140	41.7	74.0	V		NY POUCHKEEPSIE
1952	OCT	26	0905	43.6	71.2	II		NH WOLFEBORO
1953	MAR	27	0850	41.1	73.5	V		CT STAMFORD
1953	MAR	31	0250	43.7	73.0	III		VT BRANDON
1953	MAR	31	1258	43.7	73.0	V	4.0	VT BRANDON
1953	MAY	11	0613	44.0	71.1	IV		NH CONWAY
1953	AUG	17	0422	41.0	74.0	IV		NJ BERGEN CO.
1954	FEB	13		42.2	72.6	IV		MA SPRINGFIELD
1954	FEB	13		42.2	72.6	IV		MA SPRINGFIELD
1954	JUL	29	1956	42.7	70.7	V	4.0	MA CAPE ANN
1954	OCT	07		42.7	71.3	III		NH PELHAM
1955	JAN	21	0840	43.0	73.8	V		NY MALTA
1955	JAN	21	1220	43.0	73.7	V		NY MALTA
1956	SEP	21	1700	41.8	71.2	II		MA SWANSEA
1957	APR	24	0041	44.4	72.0	V		VT ST. JOHNSBURY
1958	MAY	06	1900	42.7	73.8	IV		NY ALBANY
1958	NOV	21	2330	44.0	71.7	IV		NH WOODSTOCK
1959	APR	13	2120	41.9	73.3		3.4	CT S.CANAAN
1962	APR	10	1430	44.1	73.4	V	5.0	VT MIDDLEBURY
1962	AUG	17		41.7	71.7	II		RI GREENWICH
1962	OCT	13		41.0	74.3	II		NJ POMPTON LAKE
1962	NOV	27	0415	41.5	73.8	II		NY POUGHKEEPSIE
1962	DEC	20		41.0	74.3	II		NH POMPTON LAKE

YEAR	MON	DY	TIME	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1962	DEC	29	0619	42.8	71.7	V		NH NASHUA
1963	MAY	19		43.2	73.3	III		NY HUDSON FALLS
1963	JUN	01		42.6	73.0	II		MA NORTH ADAMS
1963	JUL	01	1959	42.6	73.8		3.3	NY ALBANY
1963	OCT	17	1245	42.7	71.5	III		MA DUNSTABLE
1963	OCT	18	1543X	42.5	70.4	II	3.0	MA OFF CAPE ANN
1963	OCT	30	2236	42.7	70.8	IV (VI)	3.2	MA OFF CAPE ANN
1963	DEC	04	2132	43.7	71.4	IV (V)	3.6	NH LACONIA
1964	APR	01	1121	43.4	71.5	IV	2.4	NH LACONIA
1964	JUN	26	1104	43.3	71.5	V (VI)	3.5	NH CONCORD
1964	JUN	26	1250	43.3	71.9			NH CONCORD
1964	SEP	29	0016	41.2	73.7	III		NY MT. KISCO
1964	SEP	29	2026	41.2	73.7	III		NY MT. KISCO
1964	NOV	17	1708	41.2	73.7	V		NY MT. KISCO
1964	NOV	30		41.3	73.9	II		NY MT. KISCO
1965	JAN	03	1705	43.5	71.5	III (IV)	3.4	NH LACONIA
1965	SEP	29	2057	41.4	74.4	IV		NY GOSHEN-MIDDLETOWN
1965	OCT	24	1745	41.3	70.1	V		MA NANTUCKET
1965	OCT	24	1900	41.3	70.1			MA NANTUCKET
1965	DEC	08	0302	41.7	71.4	IV (V)		RI WARWICK
1966	APR	28	1202	44.1	71.9	IV		NH BENTON
1966	MAY	21		41.2	74.0	II		NY SOUTHEASTERN
1966	JUN	30	0029	44.0	73.4	II	2.8	NY LAKE CHAMPLAIN
1966	JUL	11	0236	42.4	71.3			MA NEAR WESTON
1966	OCT	23	2305	43.0	71.4	IV (V)	2.7	NH MANCHESTER
1967	FEB	02	1340	41.6	71.2	V	3.1	RI NARRAGANSETT BAY
1967	NOV	22	2210	41.2	73.8	V		NY WESTCHESTER CO.
1968	NOV	03	0833	41.4	72.5	V	3.3	CT MOODUS-E.HADDAM
1969	MAY	11	0303	43.1	70.5		2.1	ME OFF SOUTHWESTERN MAINE
1969	AUG	06	1602	43.8	71.4	V	2.6	NH OSSIPEE
1969	AUG	24	0151	43.1	70.5		2.4	ME OFF SOUTHWESTERN MAINE
1969	AUG	24	0259	43.1	70.4		2.1	ME OFF SOUTHWESTERN MAINE
1969	OCT	06		41.1	74.6	IV		NJ OGDENSBURG
1970	SEP	19	1335	42.9	71.9	IV	2.6	NH GREEFIELD
1971	OCT	21	0054	42.7	71.2	V	2.3	MA LAWRENCE
1972	FEB	15	2352	41.3	73.6		2.6	NY POUND RIDGE
1972	JUN	16	0901	42.8	73.9		2.0	NY SCHENECTADY
1973	JAN	10	0241	41.4	74.0		1.5	NY PEEKSKILL
1973	JAN	14	0808	41.8	72.1		1.0	CT CHAPLIN
1973	JUN	11	1008	43.9	73.9		2.8	NY E.OF BLUE MTN LAKE
1973	AUG	24	0417	43.8	72.3		2.7	VT EAST CENTRAL
1974	APR	08	2208	41.2	74.0		2.1	NY STONY POINT
1974	JUN	07	1945	41.6	73.9	VI	3.3	NY WAPPINGERS FALLS
1974	SEP	15	1401	43.9	73.9		1.7	NY SCHROON LAKE
1974	SEP	18	0623	43.4	73.8		2.5	NY SW OF LAKE GEORGE
1974	OCT	01	0636	41.7	71.6	II	2.5	RI WEST WARWICK
1974	NOV	19	0923	43.5	74.0		2.3	NY STONY CREEK
1974	DEC	27	0429	42.3	71.3		2.5	MA NEEDHAM
1974	DEC	27	1451	42.2	71.3		2.2	MA NEEDHAM
1975	JAN	27	1140	43.8	73.4		1.7	NY NEAR VT BORDER

YEAR	MON	DY	TIME	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1975	APR	29	0951	41.6	73.9		2.3	NY WAPPINGERS FALLS
1975	JUN	15	0808	41.6	73.9		2.0	NY WAPPINGERS FALLS
1975	JUL	02	0531	42.2	71.3		0.9	MA HARDING
1975	JUL	19	2059	41.4	73.8	III	2.3	NY MAHOPAC
1975	JUL	26	1126	42.7	70.7		1.1	MA CAPE ANN
1975	AUG	03	0103	42.7	70.9	III	2.4	MA IPSWITCH
1975	AUG	04	0458	43.8	74.1		2.1	NY BLUE MTN LAKE
1975	AUG	22	1749	41.1	73.9		2.3	NY LAKE DEFOREST
1975	AUG	26	2218	41.2	71.2		2.1	RI RHODE ISLAND SOUND
1975	OCT	24	0708	41.6	74.0	II	2.0	NY WAPPINGERS FALLS
1975	OCT	24	0743	41.6	73.9	II	2.2	NY WAPPINGERS FALLS
1975	OCT	28	2145	41.6	73.9	II		NY WAPPINGERS FALLS
1975	NOV	02	0409	41.7	74.0	II		NY WAPPINGERS FALLS
1975	NOV	10	0302	41.2	74.4		1.8	NY GREENWOOD LAKE
1975	NOV	16	1113	41.4	71.0		2.1	MA BUZZARDS BAY
1976	FEB	06	0915	41.7	72.2		1.9	CT MANSFIELD
1976	MAR	04	1620	41.4	70.3		2.7	MA MANTUCKET SOUND
1976	MAR	06	0414	41.2	73.8		2.3	NY OSSINING
1976	MAR	11	0829	41.6	71.2	V (VI)	2.9	RI PORTSMOUTH
1976	MAR	11	0835	41.6	71.3		1.8	RI PORTSMOUTH
1976	MAR	11	2107	41.0	74.4	V (VI)	2.4	NJ RIVERDALE
1976	MAR	12	1028	41.0	74.4		2.2	NJ RIVERDALE
1976	MAR	14	2312	41.7	70.0	V	2.8	MA S.CHATHAM
1976	APR	06	2105	41.5	72.5		1.8	CT E.HADDAM
1976	APR	24	1022	41.5	72.5	III	2.2	CT E.HADDAM
1976	APR	30	1950	41.5	72.5		1.8	CT E.HADDAM
1976	APR	30	2040X	41.5	72.5		1.9	CT E.HADDAM
1976	MAY	10	0134	41.5	71.0	IV (V)	2.7	MA NEW BEDFORD
1976	JUN	12	2100	44.2	71.6		2.4	NH FRANCONIA
1976	JUN	14	0531	44.3	71.7		2.0	NH FRANCONIA
1976	JUL	28	0204	43.1	70.2		2.3	ME OFF SW COAST
1976	SEP	22	0904	41.3	74.0		1.8	NY INDIAN PT.
1976	NOV	15	1520	43.6	71.6		1.5	NH LACONIA
1976	NOV	22	0443	41.0	73.9		1.9	NY YONKERS
1976	NOV	22	2249	43.5	71.6		1.8	NH LACONIA
1976	DEC	17	1030	41.5	72.1	II (III)	2.2	CT N.OF GALES FERRY
1976	DEC	29	0002	44.4	73.1		1.7	VT BURLINGTON
1977	FEB	07	0256	41.6	72.4		2.1	CT MARLBOROUGH
1977	MAR	07	0944	41.6	72.4		1.8	CT MARLBOROUGH
1977	MAR	10	1622	41.2	74.2		2.2	NY SUFFERN
1977	APR	06	2031	41.1	70.4		2.5	MA S. OF MARTHA'S VINEYARD
1977	MAY	05	0839	43.9	72.3		2.1	VT LAKE FAIRLEE
1977	SEP	02	0553	41.3	73.9		2.4	NY PEEKSKILL
1977	SEP	02	1309	41.3	73.9			NY PEEKSKILL
1977	SEP	02	2222	41.3	73.9			NY PEEKSKILL
1977	SEP	03	0004	41.3	73.9			NY PEEKSKILL
1977	SEP	03	0008	41.3	73.9			NY PEEKSKILL
1977	SEP	08	2359	43.6	70.7		1.8	ME LITTLE OSSIPEE POND
1977	SEP	14	1106	41.3	73.9			NY PEEKSKILL
1977	SEP	17	1847	41.2	74.1			NY HAVERSTRAW

YEAR	MON	DY	TIME	LOCATION LAT.	LONG.	MODIFIED MERCALLI INTENSITY	MAG	GEOGRAPHIC LOCATION
1977	SEP	29	1844	41.3	73.9			NY PEEKSKILL
1977	OCT	14	0922	41.6	74.0		2.2	NY NEWBURGH
1977	OCT	27	0922	41.1	74.6		1.5	NJ SPARTA
1977	NOV	16	0255	41.0	71.5		2.2	NY MONTAUK PT.
1977	NOV	27	1357	41.0	74.2		1.8	NJ OAKLAND
1977	DEC	09	1733	41.6	73.9		2.3	NY HOPEWELL JCT
1977	DEC	20	1744	41.8	70.7	IV (V)	3.1	MA WAREHAM
1977	DEC	20	2244	41.8	70.8	III	2.0	MA WAREHAM
1977	DEC	25	1535	43.2	71.7	IV	3.2	NH HOPKINTON

Supplemental Earthquakes from Stover and von Hake (1980, 1981, and 1982)

1978	JAN	04	1928	44.04	70.51	IV	3.2	SOUTHWESTERN ME
1978	MAR	05	0753	41.35	74.15	III	2.1	SOUTHEASTERN NY
1978	MAR	31	1427	43.10	71.63		2.7	SOUTH CENTRAL NH
1978	APR	05	1445	43.86	74.24		2.6	EAST CENTRAL NY
1978	JUN	30	2013	41.07	74.20	IV	2.9	NORTHERN NJ
1978	JUN	30	2239	41.08	74.20	III	2.2	NORTHERN NJ
1978	AUG	21	0847	44.52	74.51		3.1	SOUTH OF ST. REGIS FALLS
1978	AUG	25	2001	42.87	70.83	III	2.3	SOUTHEASTERN NH
1978	SEP	01	0333	42.48	71.46	III	2.0	EASTERN MA
1978	SEP	03	1241	41.36	71.37		2.8	RI OFF NEWPORT COAST
1979	JAN	29	0635	44.82	73.19	II	2.5	NORTHWESTERN VT
1979	FEB	02	0226	40.77	74.66	III	1.9	NEWARK NJ
1979	FEB	23	1023	40.80	74.81	IV	2.9	NORTHERN NJ
1979	MAR	10	0449	40.72	74.50	V	2.2	NORTHERN NJ
1979	APR	18	0234	43.95	69.75	V	4.1	SOUTHERN ME
1979	APR	23	0005	43.04	71.24	IV	3.1	SOUTHERN NH
1979	JUN	07	1345	44.43	73.86		3.1	EASTERN NY
1979	JUN	20	1920	41.35	74.38		3.0	SOUTHEASTERN NY
1979	JUL	28	2329	43.29	70.44	IV	3.5	SOUTHERN ME COAST
1979	DEC	30	1415	41.16	73.71	IV	2.0	SOUTHEASTERN NY
1980	JAN	17	1013	41.31	73.93	V	2.9	SOUTHEASTERN NY
1980	FEB	09	1311	43.56	70.76	II	2.4	SOUTHWESTERN ME
1980	FEB	29	0553	42.58	74.20		3.1	SW OF SCHENECTADY NY
1980	APR	07	0936	43.13	72.22		2.7	SOUTHWESTERN NH
1980	MAY	07	0432	41.02	73.87		2.6	SOUTHEASTERN NY
1980	MAY	20	2133	41.35	74.37		2.6	SOUTHEASTERN NY
1980	JUN	12	1849	44.37	74.10		2.6	NORTHEAST NY
1980	SEP	04	0430	41.11	73.78	IV	3.2	SOUTHEASTERN NY
1980	SEP	21	2054	43.63	74.02		3.2	EAST CENTRAL NY
1980	SEP	27	0048	41.54	73.69		2.5	SOUTHEASTERN NY
1980	SEP	28	2219	43.77	74.12		3.0	EAST CENTRAL NY
1980	OCT	24	1727	41.32	72.87	IV	2.8	NEW HAVEN CT
1980	OCT	25	0041	41.33	72.88	IV	2.7	NEW HAVEN CT
1980	NOV	05	2240	43.66	71.36		2.7	EAST CENTRAL NH
1980	NOV	23	0039	42.62	71.39	V	2.5	NORTHEASTERN MA
1980	DEC	25	1658	44.10	72.09		2.5	EAST CENTRAL VT

APPENDIX B: SELECTED ACCELEROGRAMS, RELATIVE VELOCITY RESPONSE SPECTRA, AND QUADRIPARTITE RESPONSE SPECTRA FROM CALIFORNIA INSTITUTE OF TECHNOLOGY (1971-1975)

ZONE TWO

1. San Fernando, CA, Lake Hughes Array No. 1, N21E, 2/9/71
2. San Fernando, CA, 3838 Lankershim Blvd., basement, N00E, 2/9/71
3. San Fernando, CA, 3838 Lankershim Blvd., basement, S90W, 2/9/71
4. San Fernando, CA, Griffith Park Obs., S90W, 2/9/71

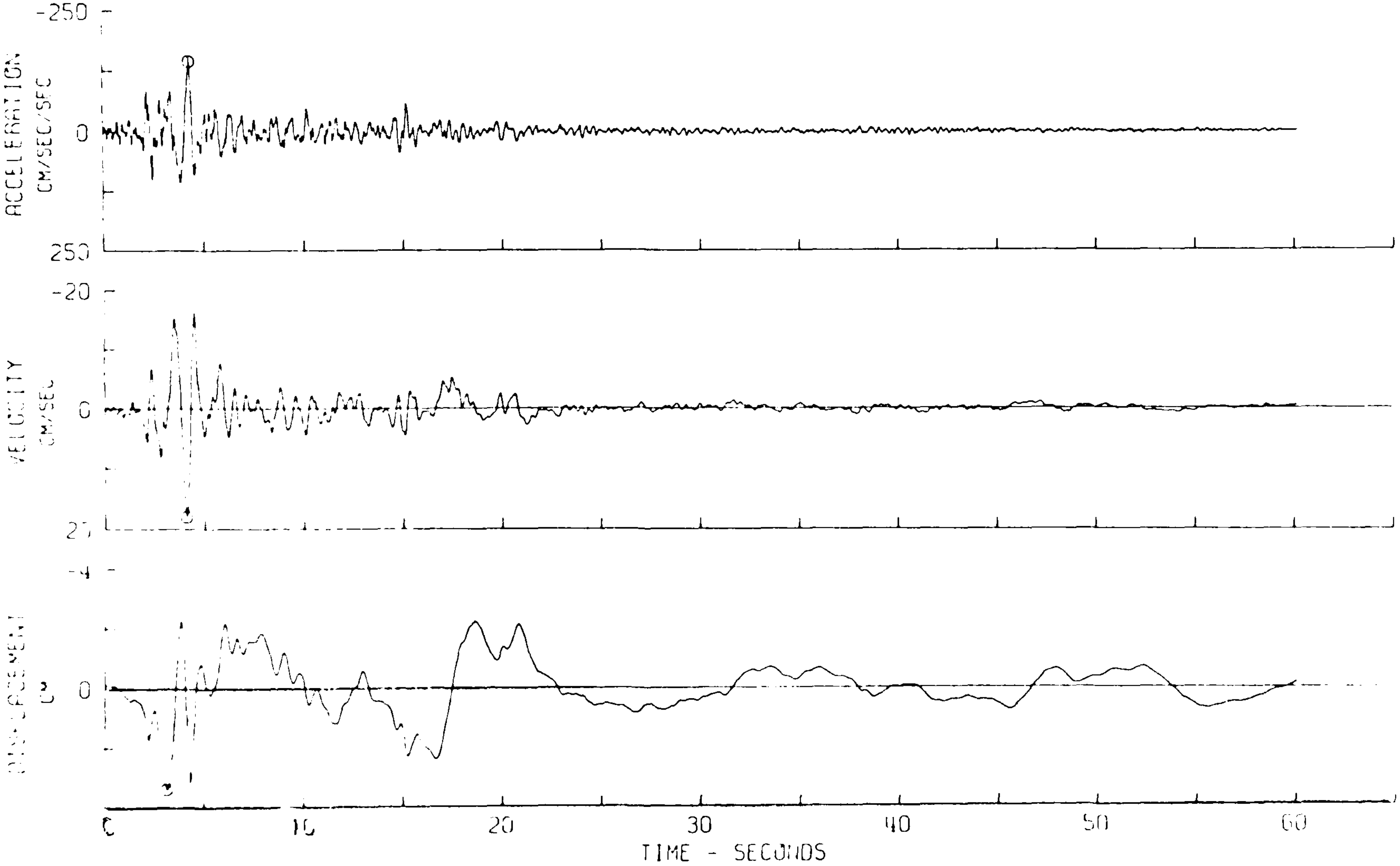
CAPE ANN (INNER AREA)

5. Kern County, CA, Santa Barbara Courthouse, 7/21/52
6. Kern County, CA, Hollywood Storage P.E. Lot, 7/21/52
7. San Fernando, CA, Puddingstone Res., 2/9/71

SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST

IIJ141 71.152.0 LAKE HUGHES, ARRAY STATION 1, CAL. COMP N21E

⊙ PEAK VALUES : ACCEL = -145.5 CM/SEC/SEC VELOCITY = 18.0 CM/SEC DISPL = 3.4 CM

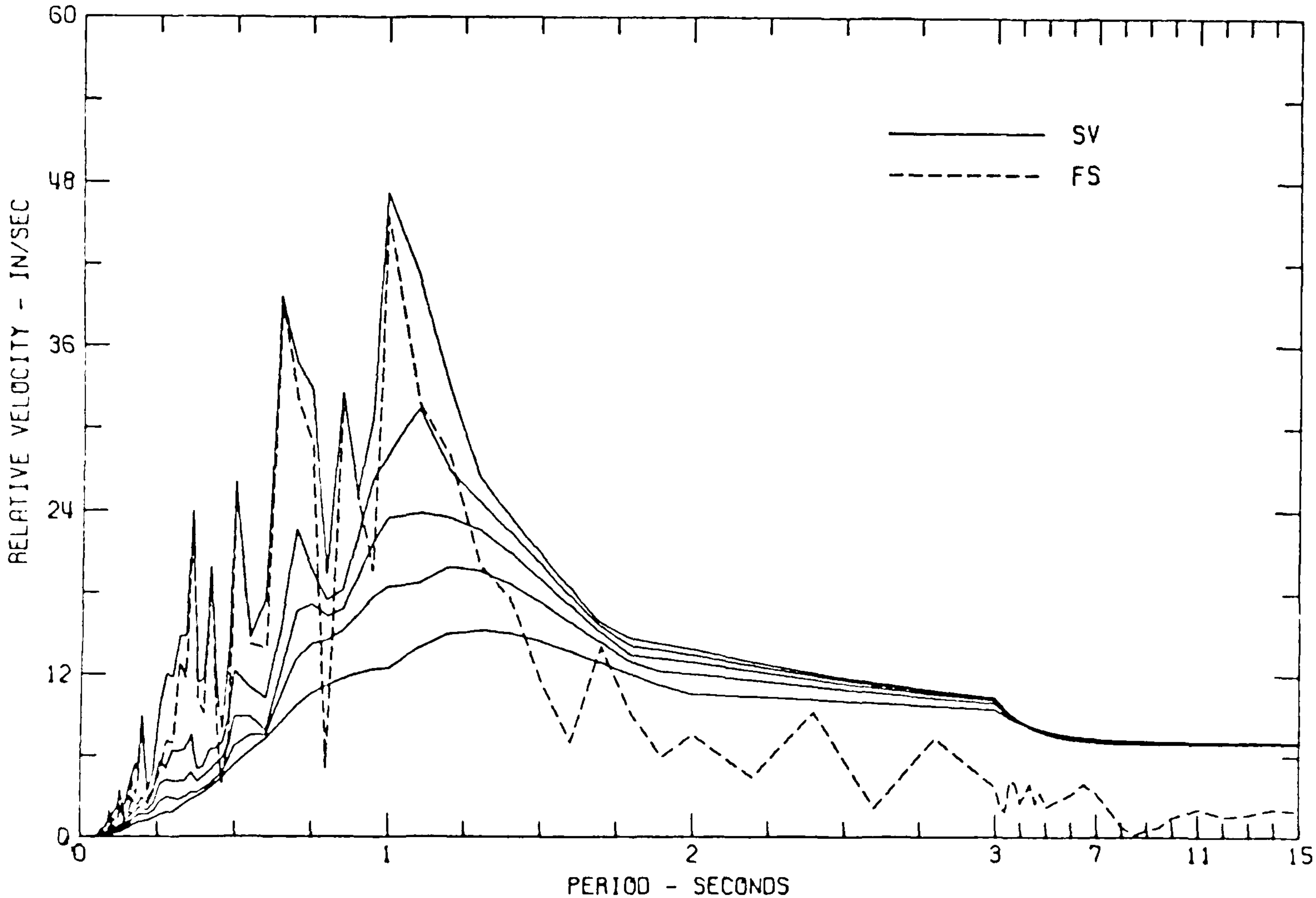


RELATIVE VELOCITY RESPONSE SPECTRUM

SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST

III J141 71.152.0 LAKE HUGHES, ARRAY STATION 1, CAL. COMP N21E

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL

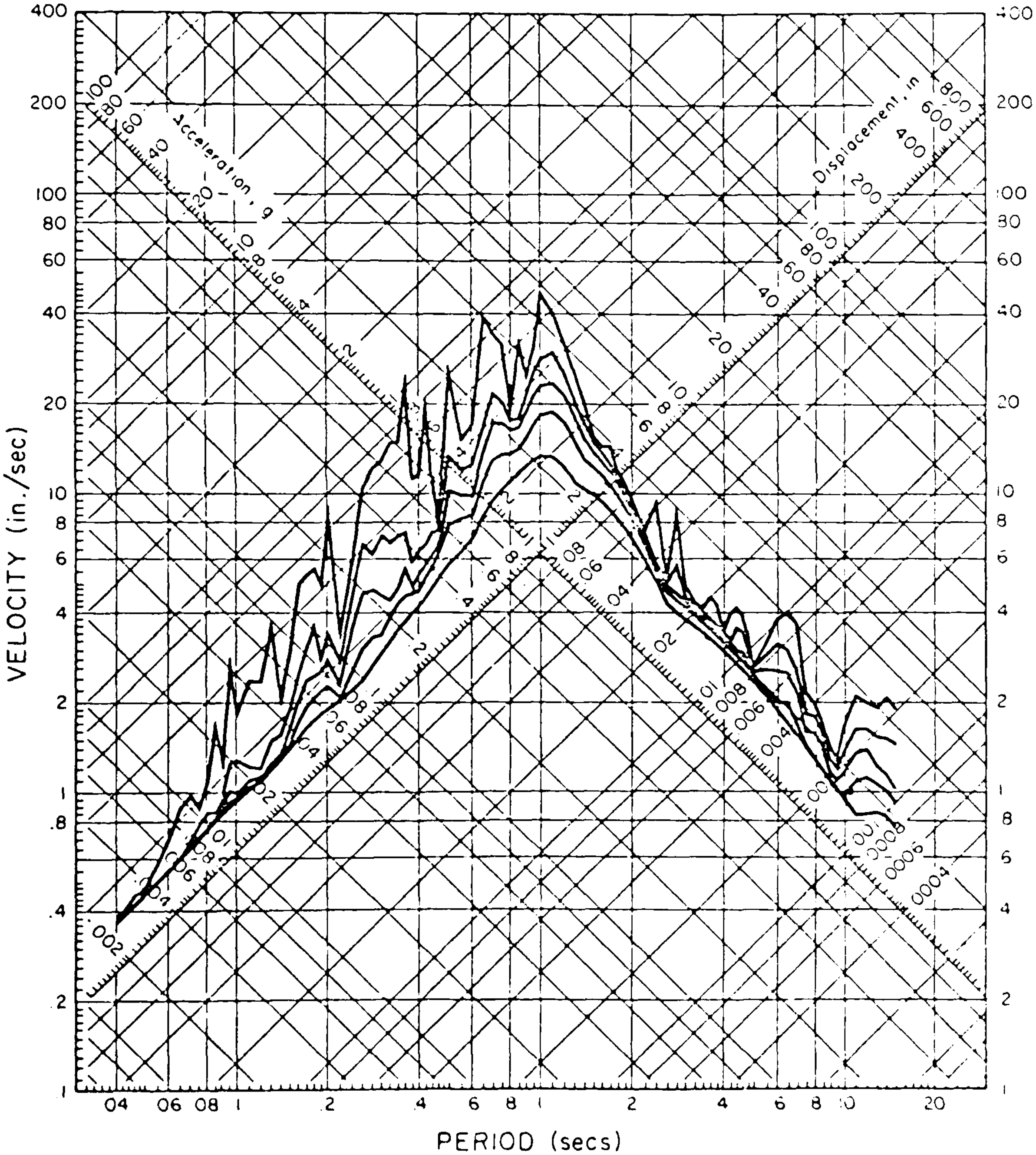


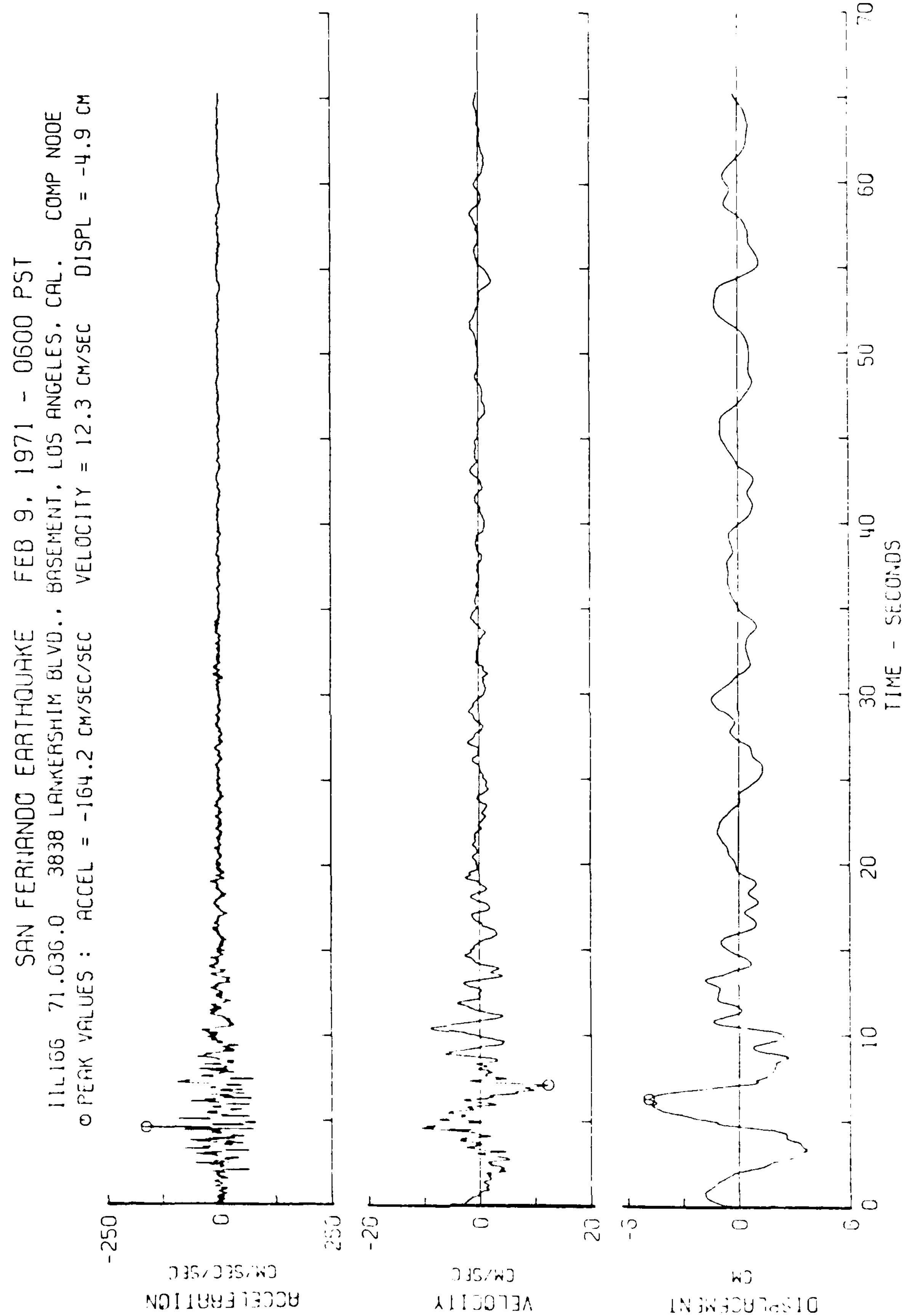
RESPONSE SPECTRUM

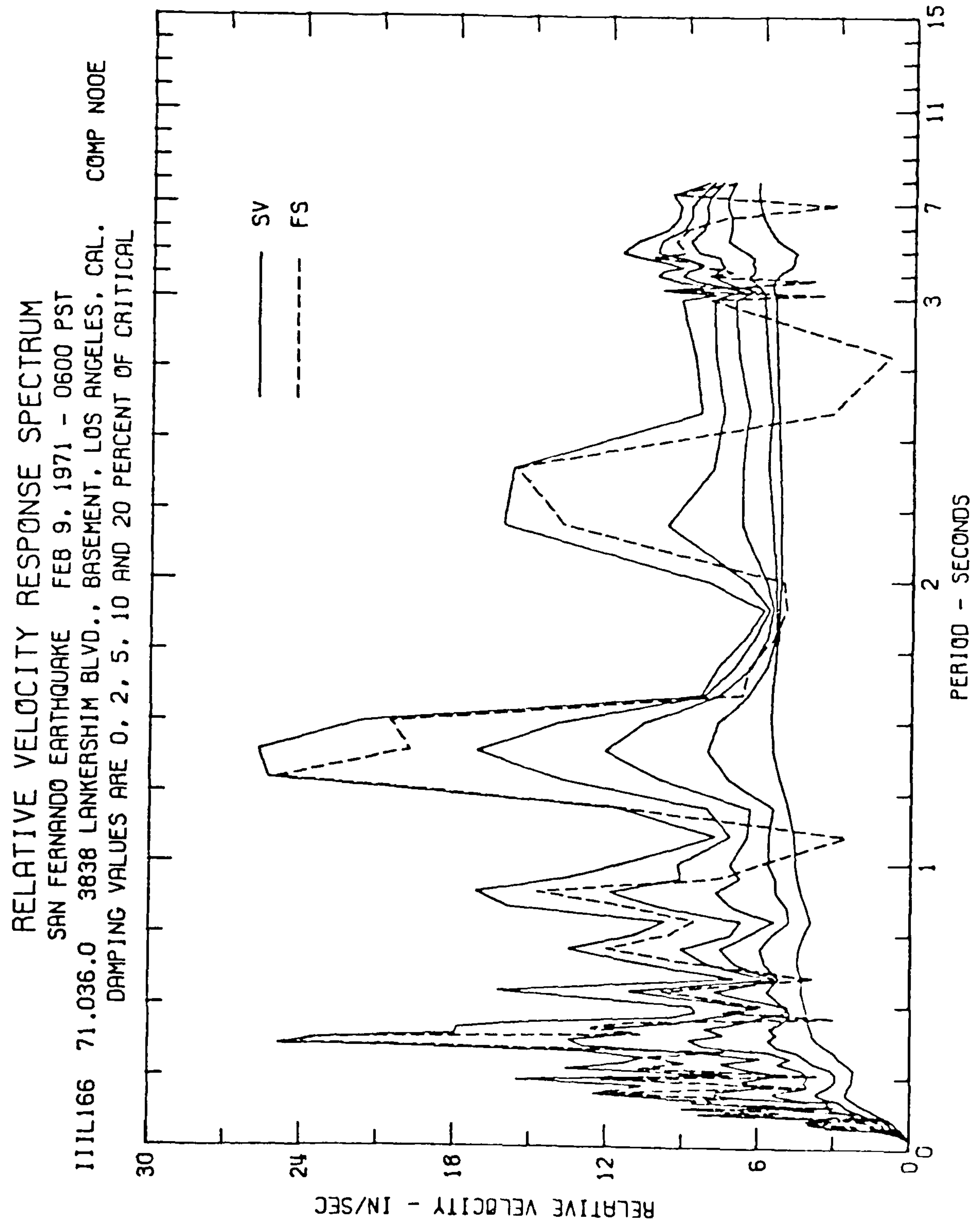
SAN FERNANDO EARTHQUAKE   FEB 9, 1971 - 0600 PST

IIIJ141 71.152.0   LAKE HUGHES, ARRAY STATION 1, CAL.   COMP N21E

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL




SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST
IIL166 71.036.0 3838 LANKERSHIM BLVD., BASEMENT, LOS ANGELES, CAL. COMP N00E
PEAK VALUES : ACCEL = -164.2 CM/SEC/SEC VELOCITY = 12.3 CM/SEC DISPL = -4.9 CM
ACCELERATION CM/SEC/SEC
VELOCITY CM/SEC
DISPLACEMENT CM
TIME - SECONDS
-250
0
250
-20
0
20
-5
0
5
0
10
20
30
40
50
60
70

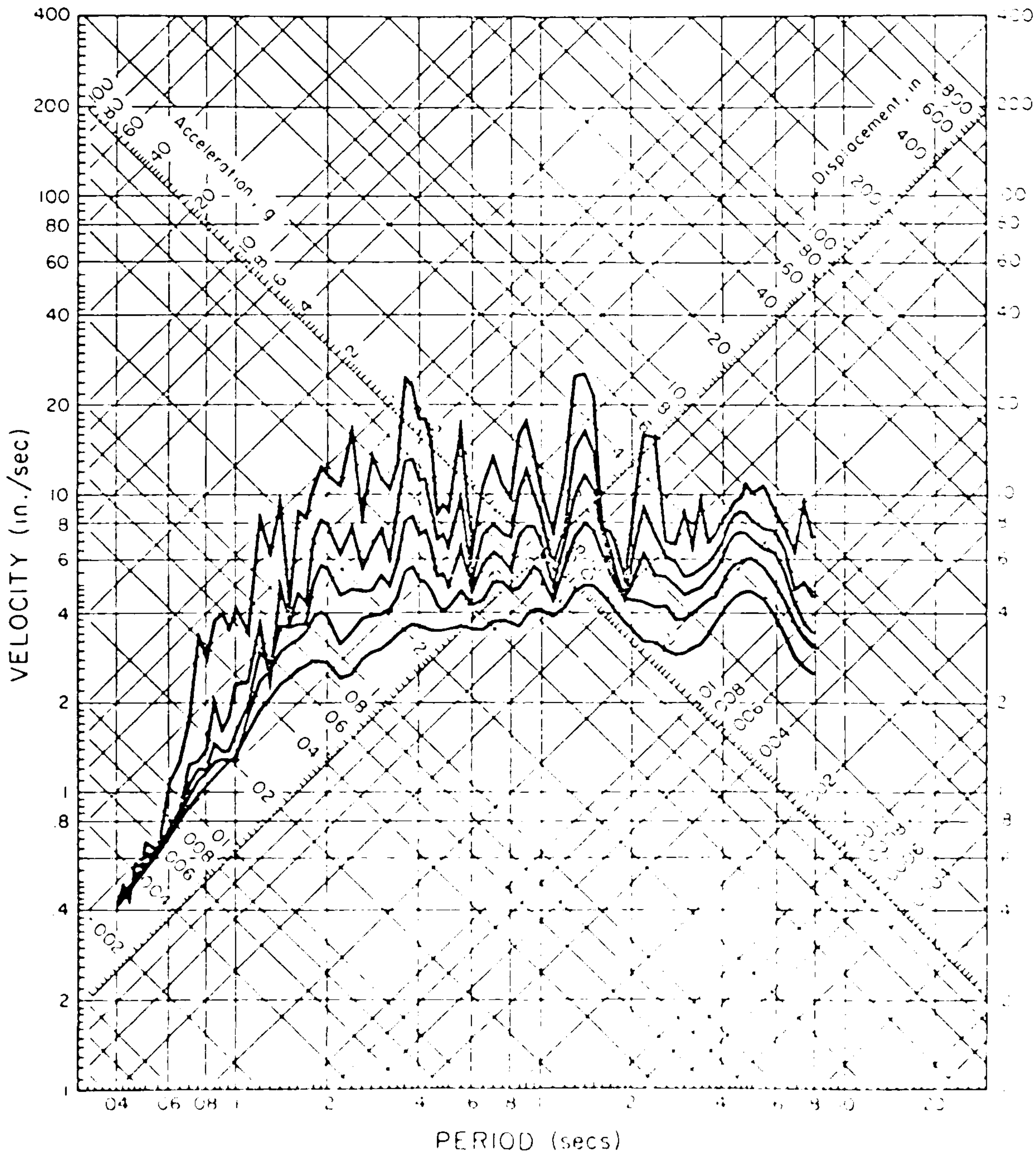

RELATIVE VELOCITY RESPONSE SPECTRUM
SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST
IIIL166 71.036.0 3838 LANKERSHIM BLVD., BASEMENT, LOS ANGELES, CAL. COMP N00E
DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL
SV
FS
RELATIVE VELOCITY - IN/SEC
PERIOD - SECONDS
0
6
12
18
24
30
0
1
2
3
7
11
15

RESPONSE SPECTRUM

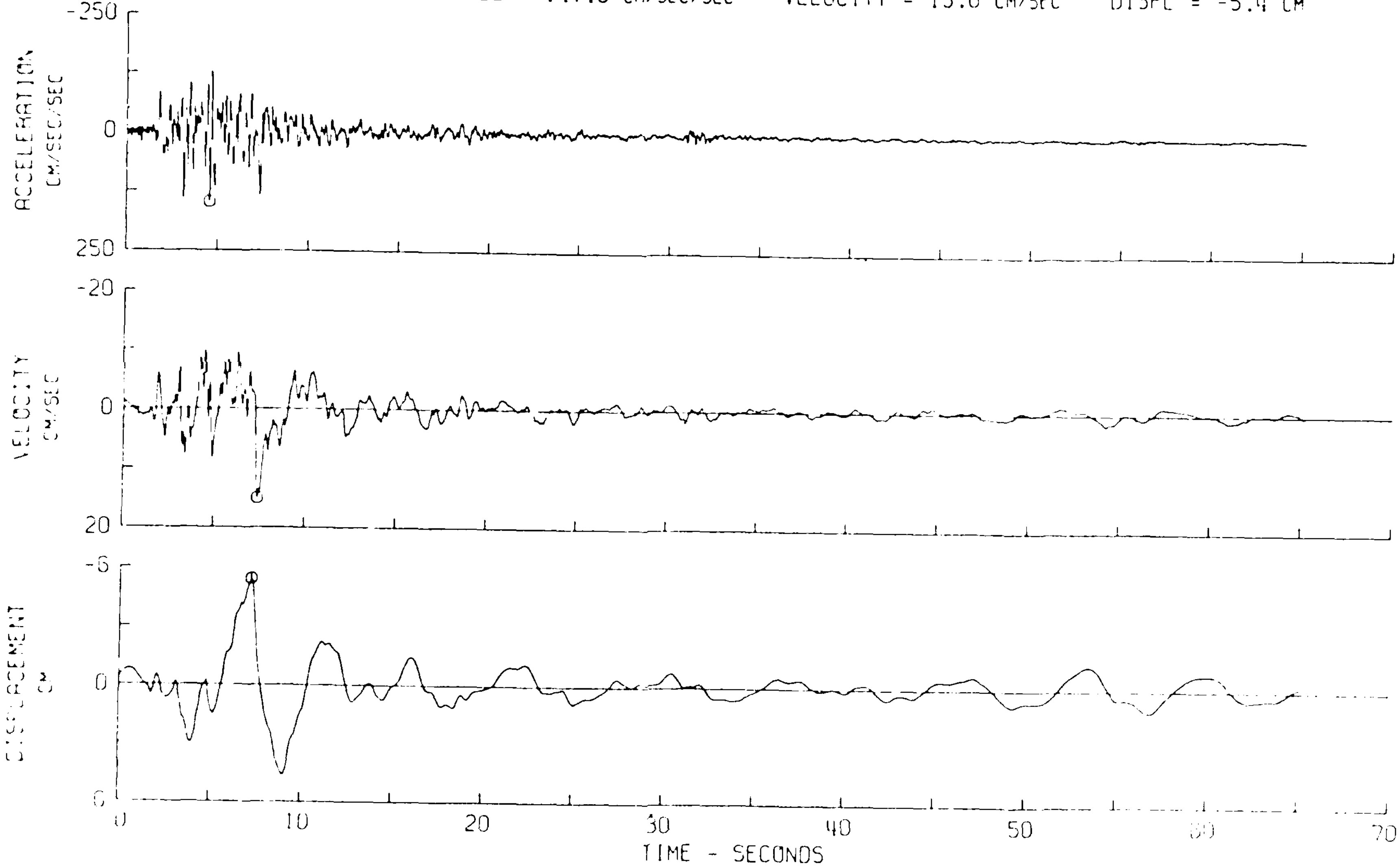
SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST

IIIL166 71.036.0 3838 LANKERSHIM BLVD., BASEMENT, LOS ANGELES, CAL. COMP N00E

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL



SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST
IIL166 71.036.0 3838 LANKERSHIM BLVD., BASEMENT, LOS ANGELES, CAL. COMP S90W
© PEAK VALUES : ACCEL = 147.6 CM/SEC/SEC VELOCITY = 15.0 CM/SEC DISPL = -5.4 CM

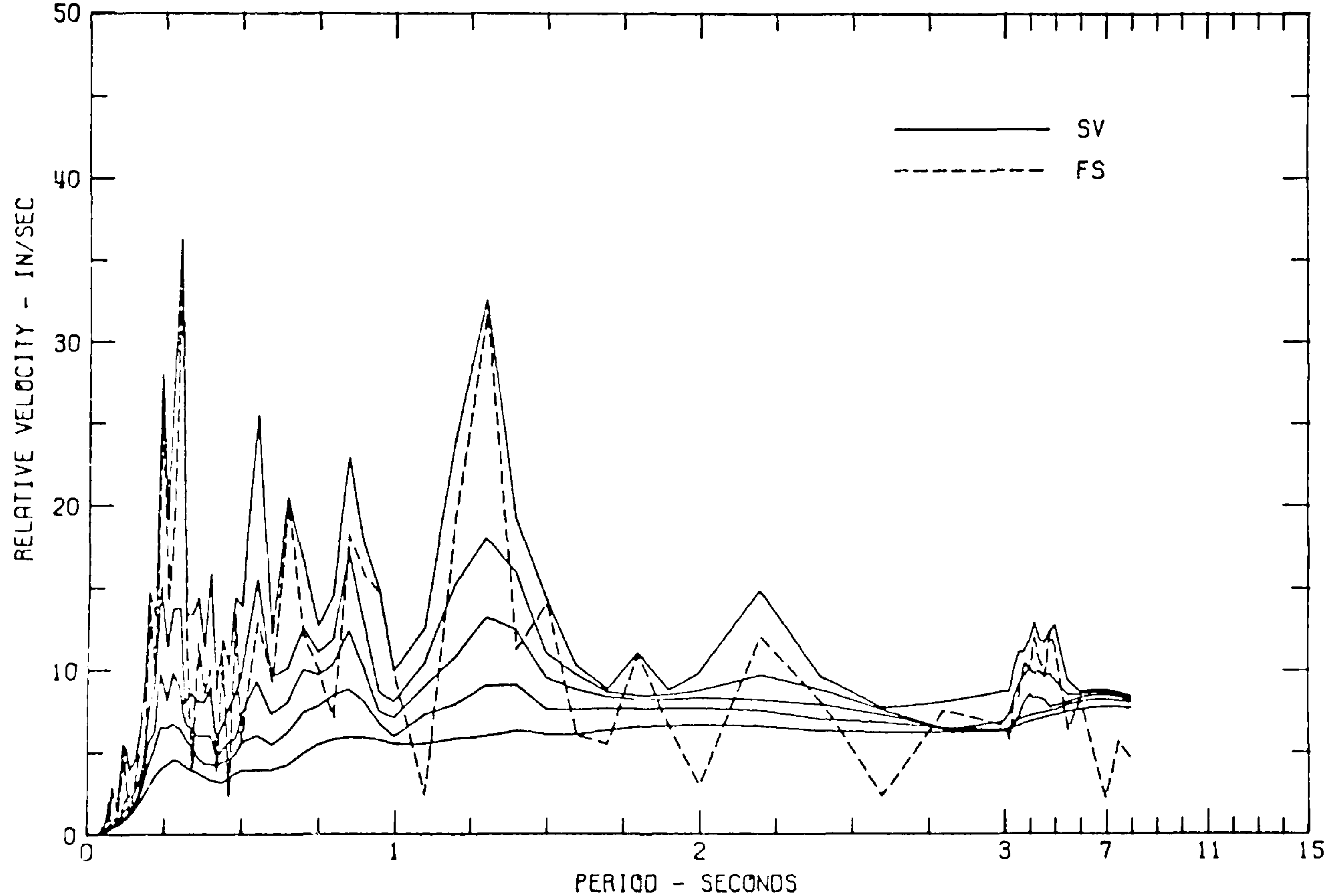


RELATIVE VELOCITY RESPONSE SPECTRUM

SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST

IIIL166 71.036.0 3838 LANKERSHIM BLVD., BASEMENT, LOS ANGELES, CAL. COMP S90W

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL

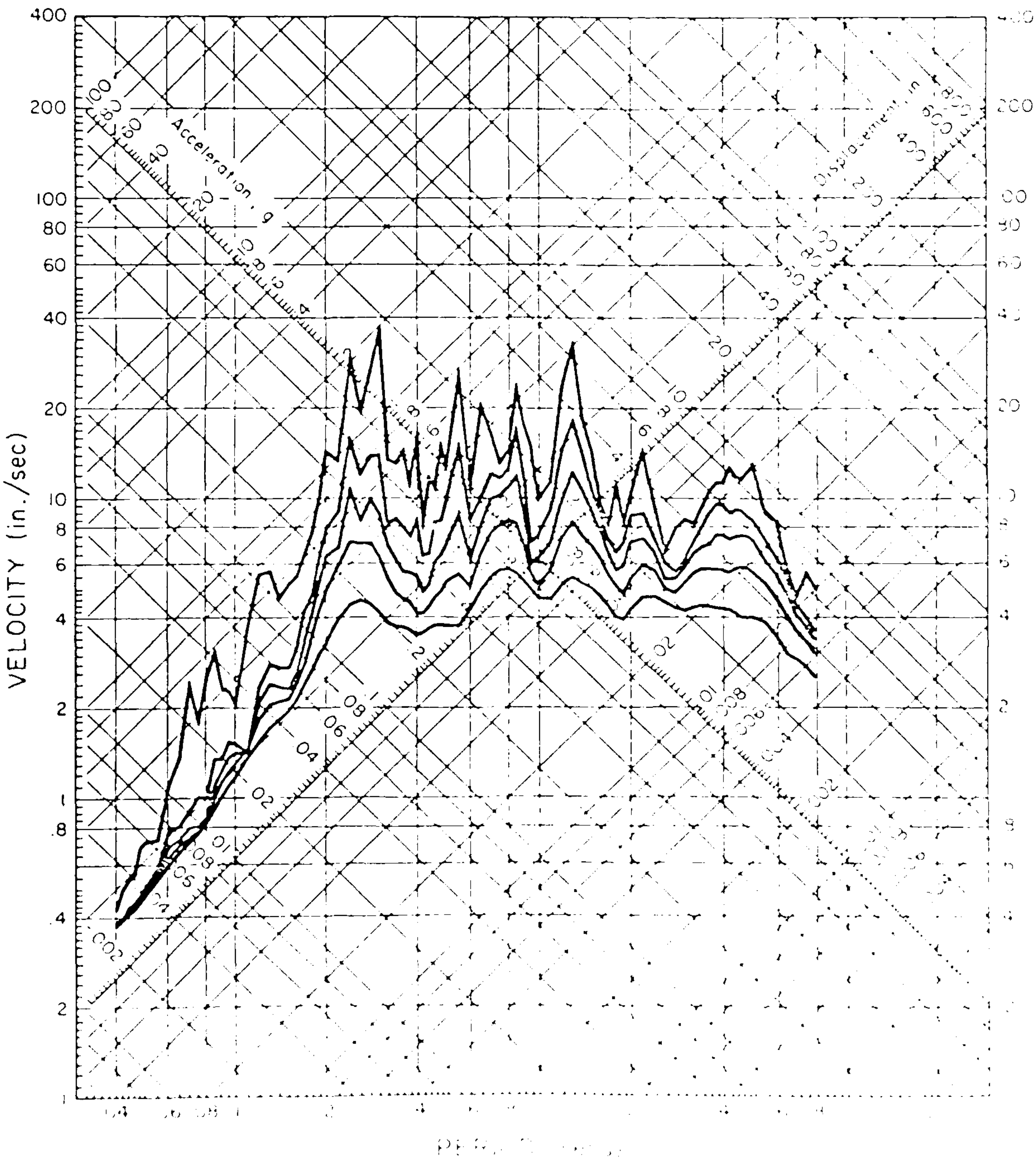


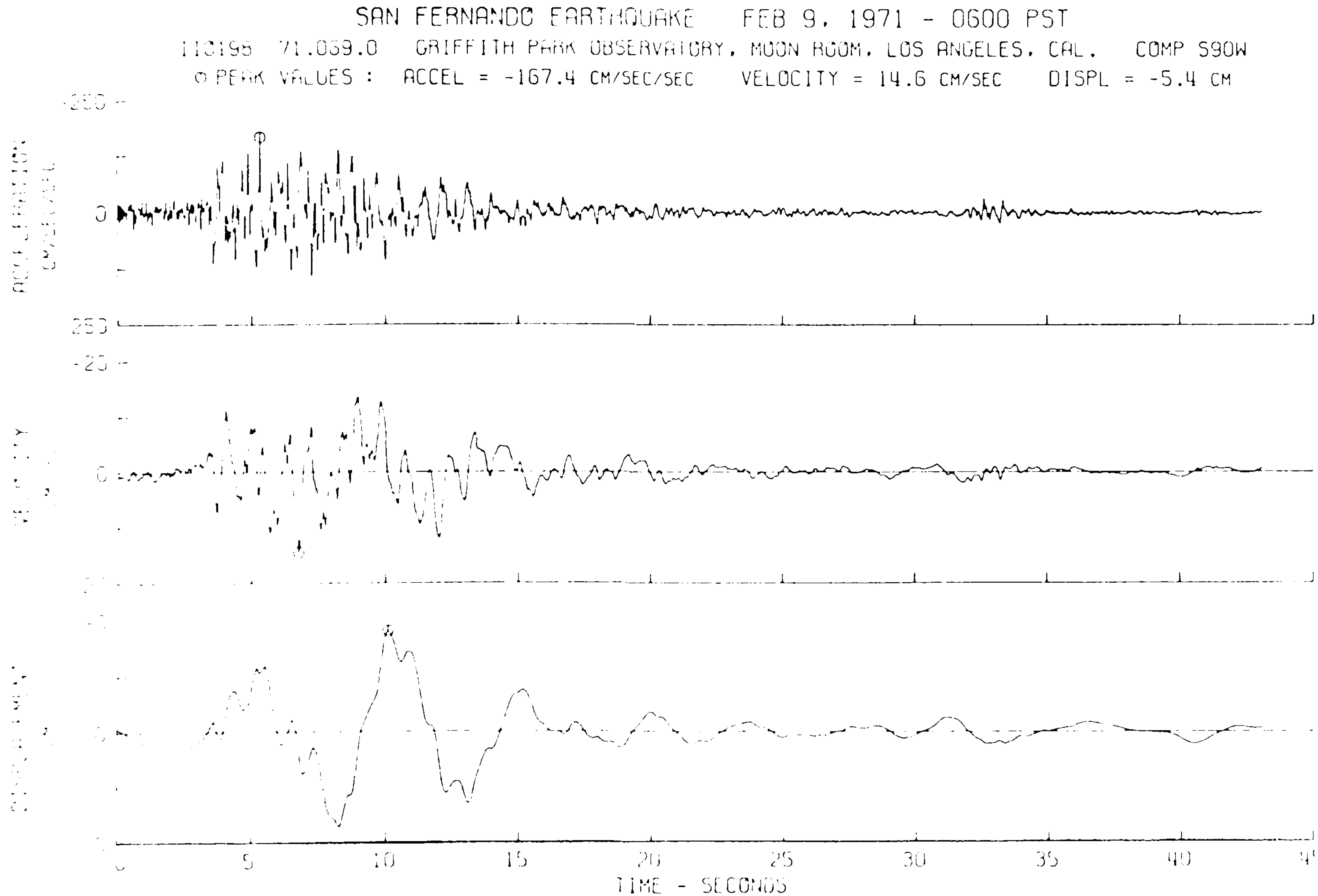
RESPONSE SPECTRUM

SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST

IIIL166 71.036.0 3838 LANKERSHIM BLVD., BASEMENT, LOS ANGELES, CAL. COMP S90W

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL



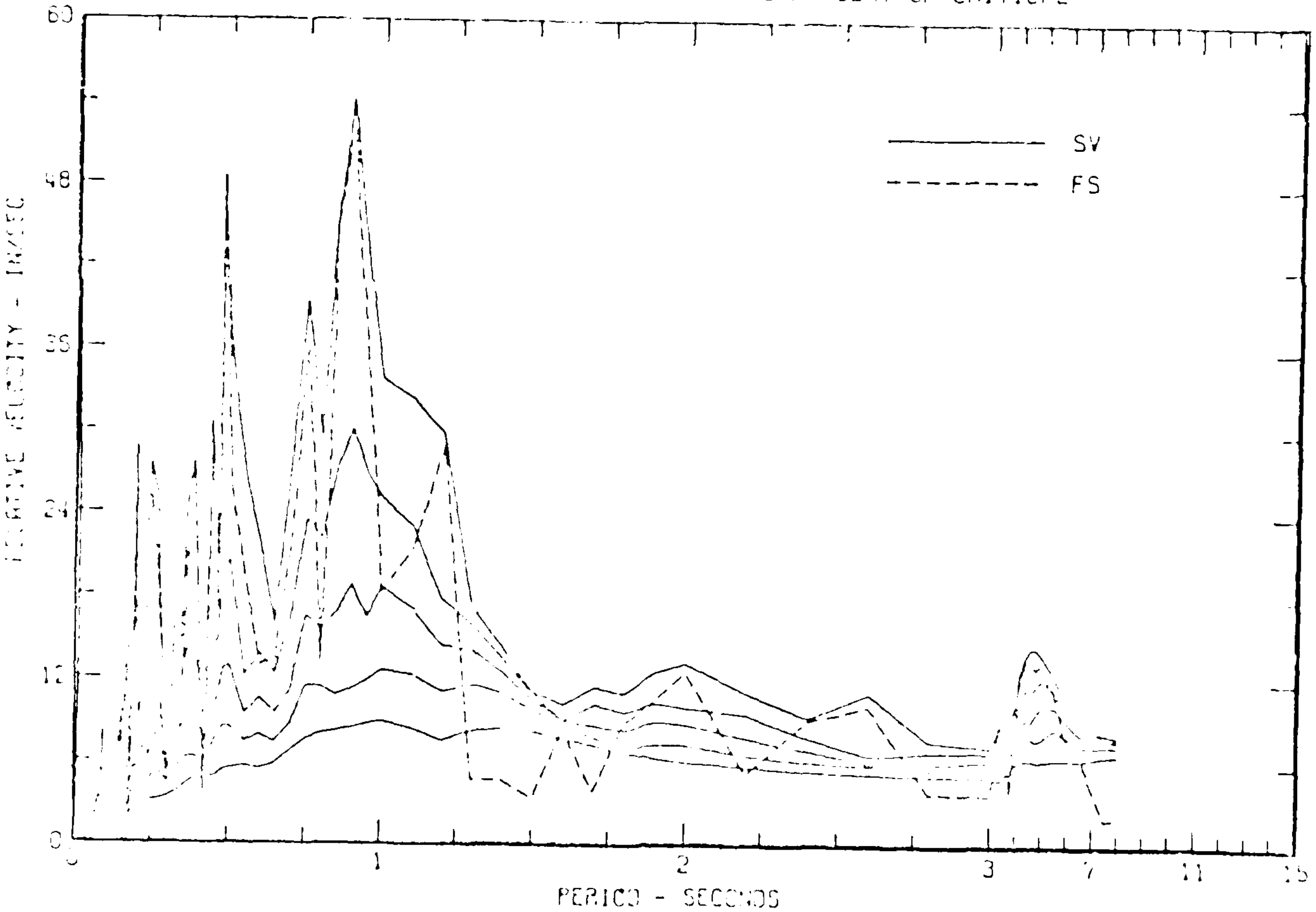

SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST
IIC196 71.039.0 GRIFFITH PARK OBSERVATORY, MOON ROOM, LOS ANGELES, CAL. COMP S90W
PEAK VALUES : ACCEL = -167.4 CM/SEC/SEC VELOCITY = 14.6 CM/SEC DISPL = -5.4 CM
-250
0
250
-20
0
0
5
10
15
20
25
30
35
40
45
TIME - SECONDS

RELATIVE VELOCITY RESPONSE SPECTRUM

SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST

IIIC198 71.083.0 GRIFFITH PARK OBSERVATORY, MOON ROOM, LOS ANGELES, CAL. COMP S00W

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL

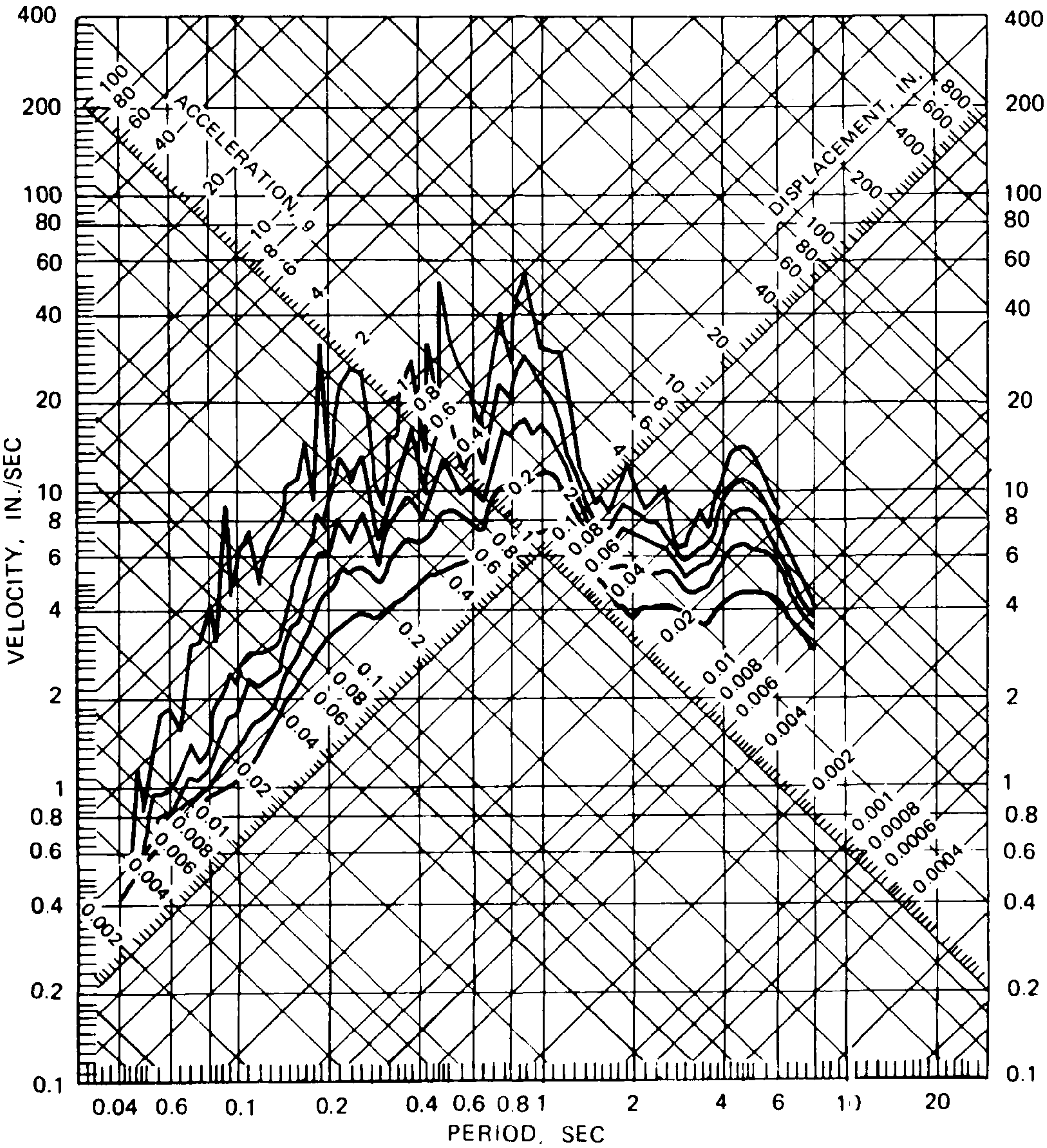


RESPONSE SPECTRUM

SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST

IIIJ193 71.059.0 GRIFFITH PARK OBSERVATORY, MOON ROOM, LOS ANGELES, CAL. COMP S90W

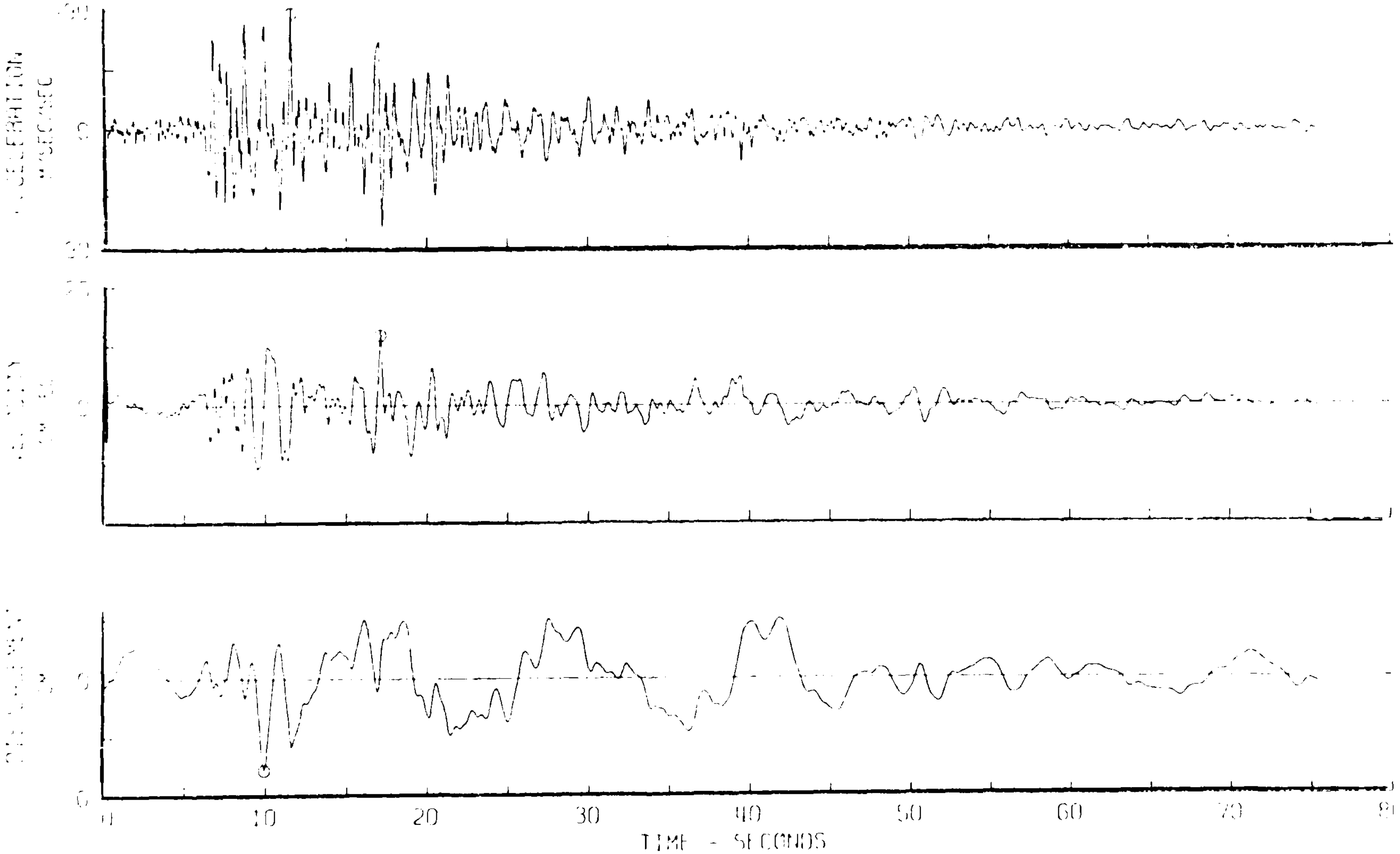
DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL



KERN COUNTY, CALIFORNIA EARTHQUAKE   JULY 21, 1952 - 0453 PDT

IIA005 52.003.0   SANTA BARBARA COURTHOUSE   COMP N42E

PEAK VALUES : ACCEL = -87.8 CM/SEC/SEC   VELOCITY = -11.8 CM/SEC   DISPL = 4.3 CM

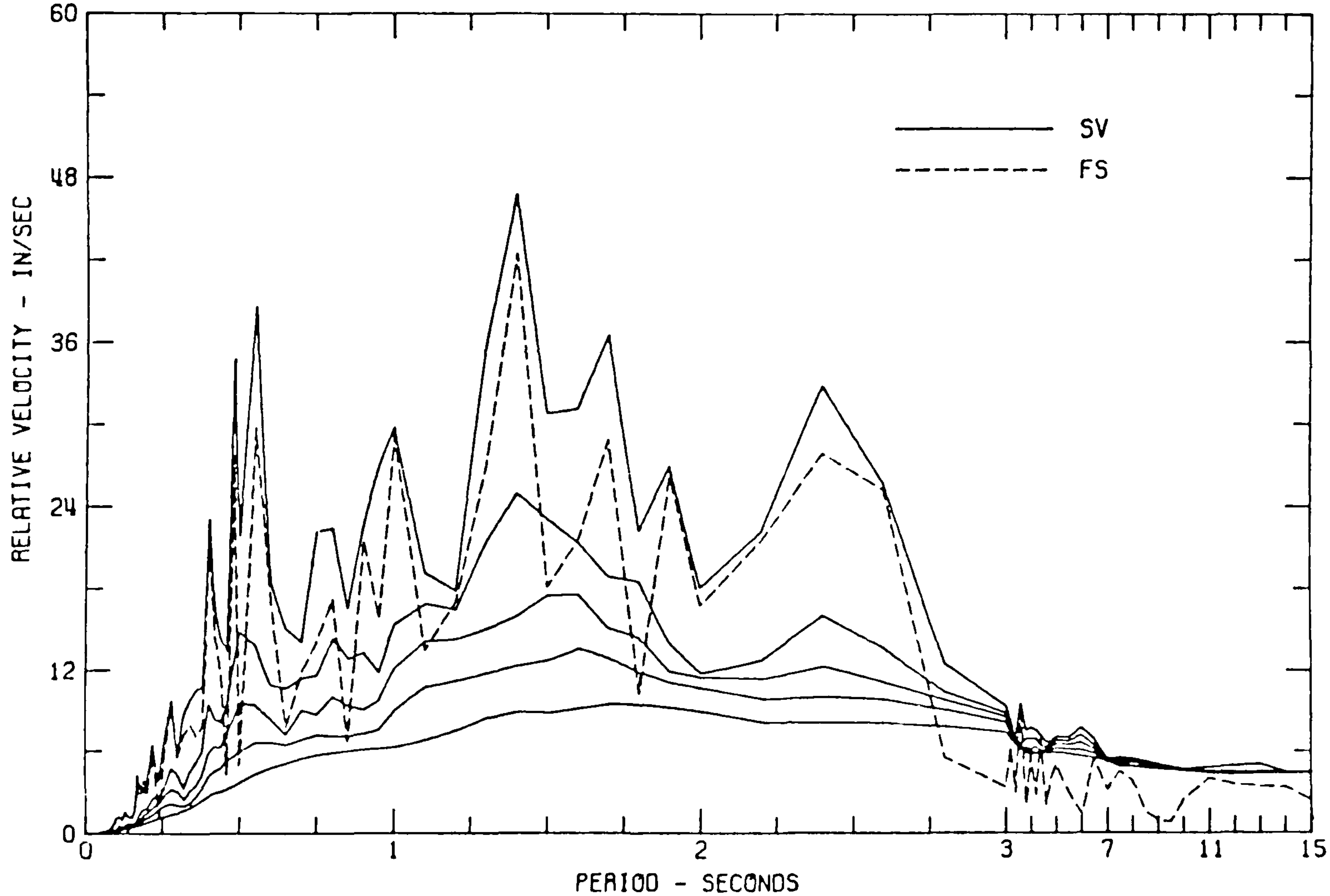


RELATIVE VELOCITY RESPONSE SPECTRUM

KERN COUNTY, CALIFORNIA EARTHQUAKE JULY 21, 1952 - 0453 PDT

IIIA005 52.003.0 SANTA BARBARA COURTHOUSE COMP N42E

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL

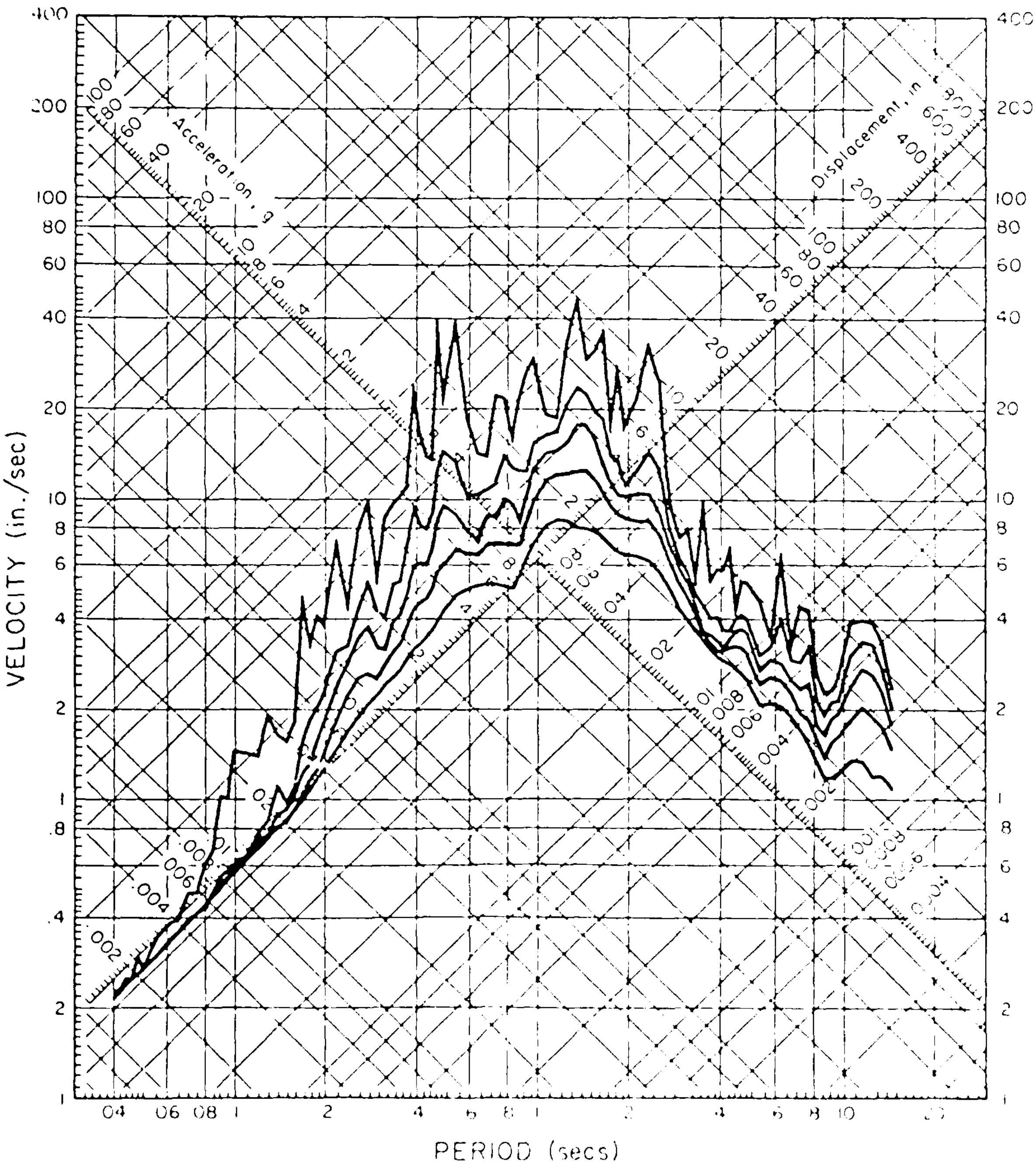


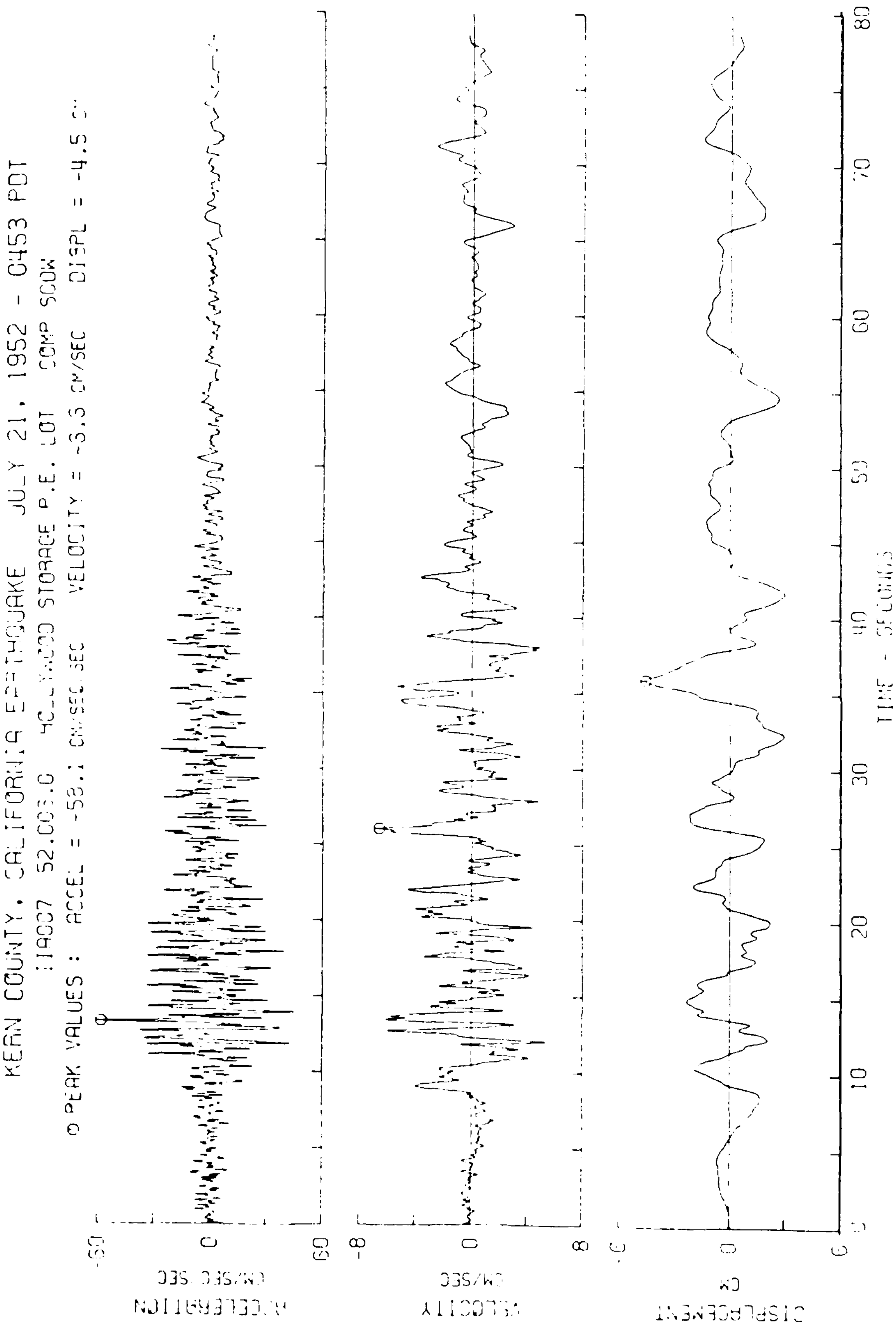
RESPONSE SPECTRUM

KERN COUNTY, CALIFORNIA EARTHQUAKE JULY 21, 1952 - 0453 PDT

IIIA005 52.003.0 SANTA BARBARA COURTHOUSE COMP N42E

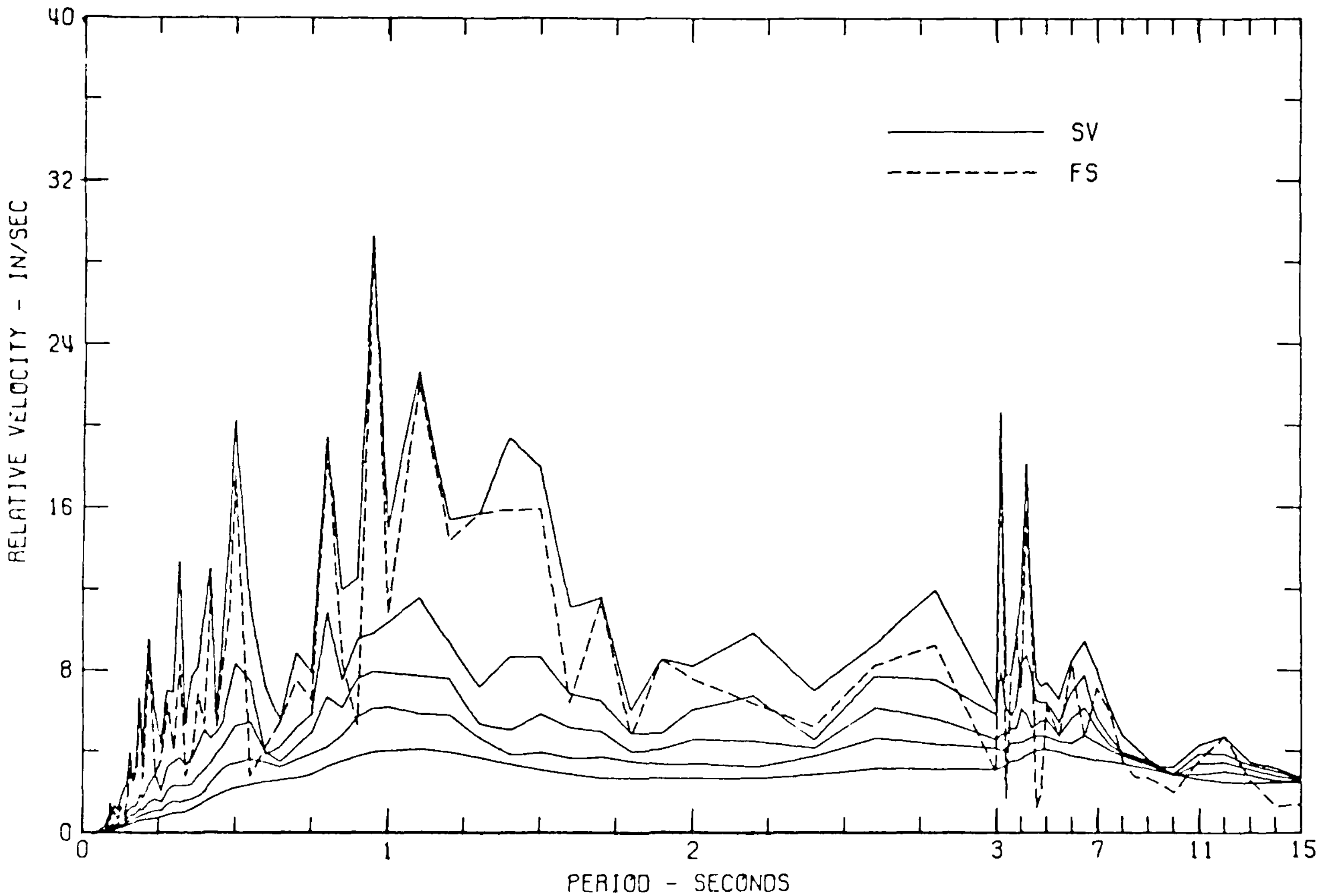
DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL





KERN COUNTY, CALIFORNIA EARTHQUAKE JULY 21, 1952 - 0453 PDT
ACCELERATION
CM/SEC/SEC
VELOCITY
CM/SEC
DISPLACEMENT
CM
TIME - SECONDS

RELATIVE VELOCITY RESPONSE SPECTRUM
KERN COUNTY, CALIFORNIA EARTHQUAKE JULY 21, 1952 - 0453 PDT
IIIA007 52.006.0 HOLLYWOOD STORAGE P.E. LOT COMP S00W
DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL

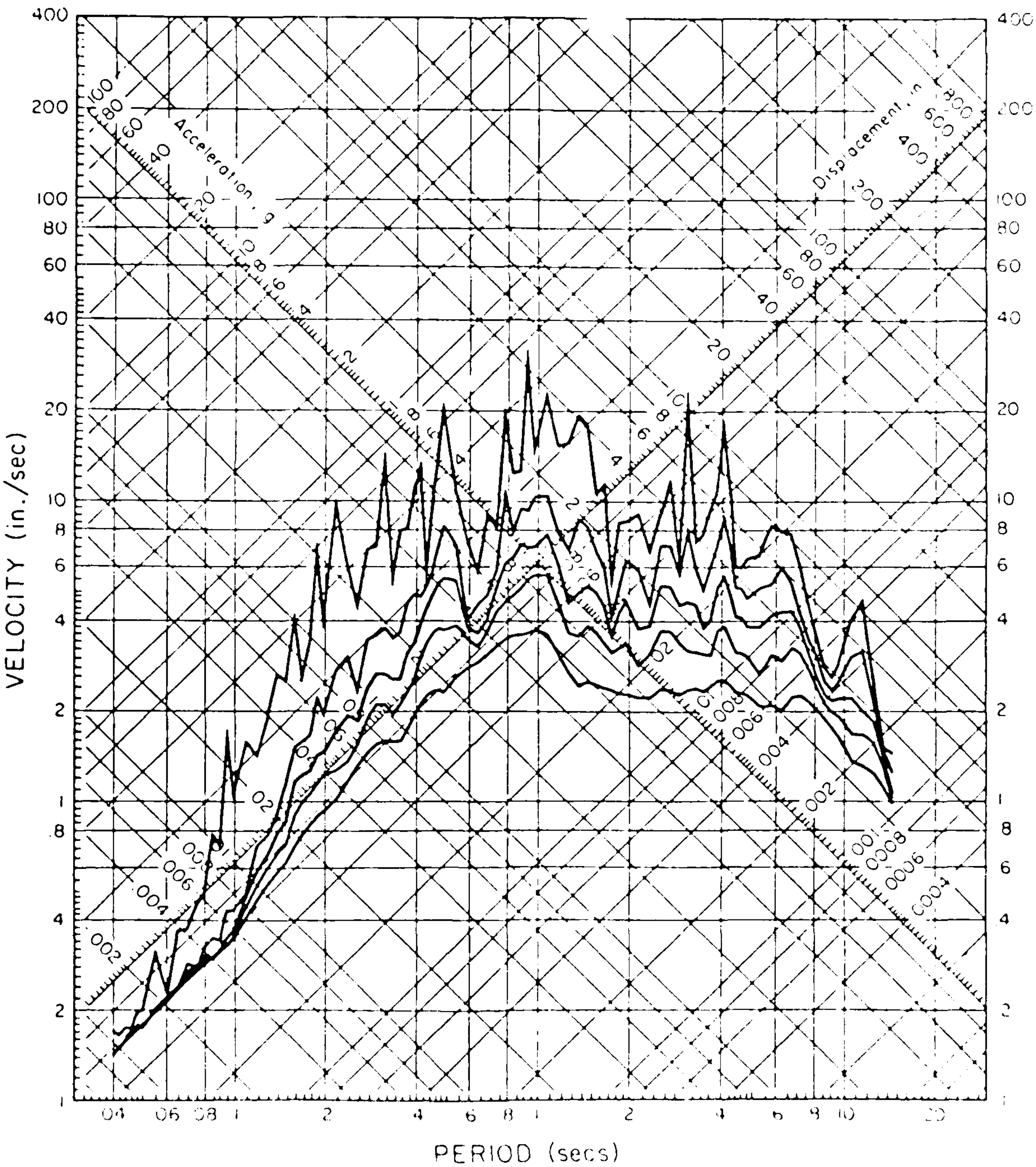


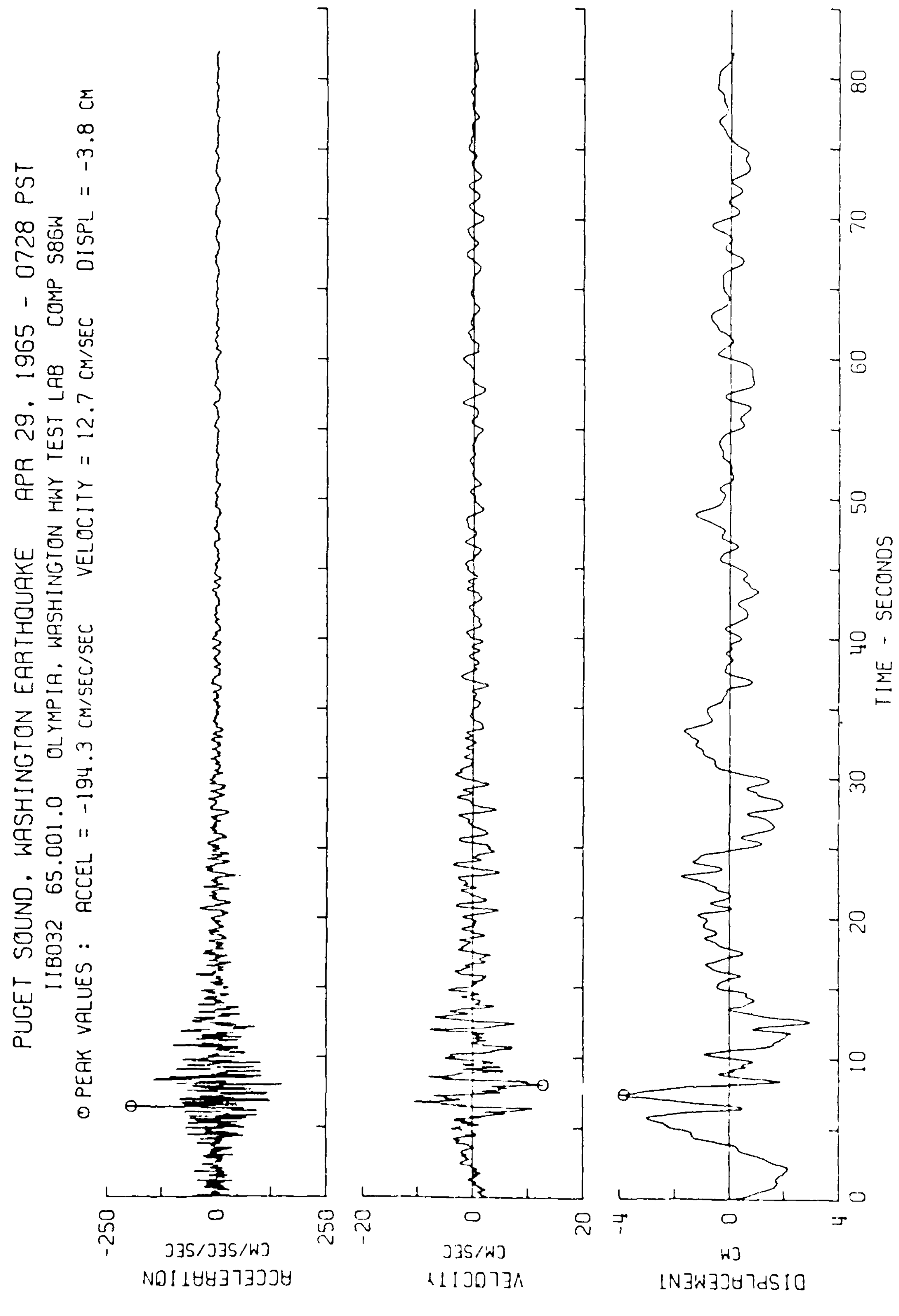
RESPONSE SPECTRUM

KERN COUNTY, CALIFORNIA EARTHQUAKE   JULY 21, 1952 - 0453 PDT

IIIA007 52.006.0   HOLLYWOOD STORAGE P.E. LOT   COMP SOOW

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL





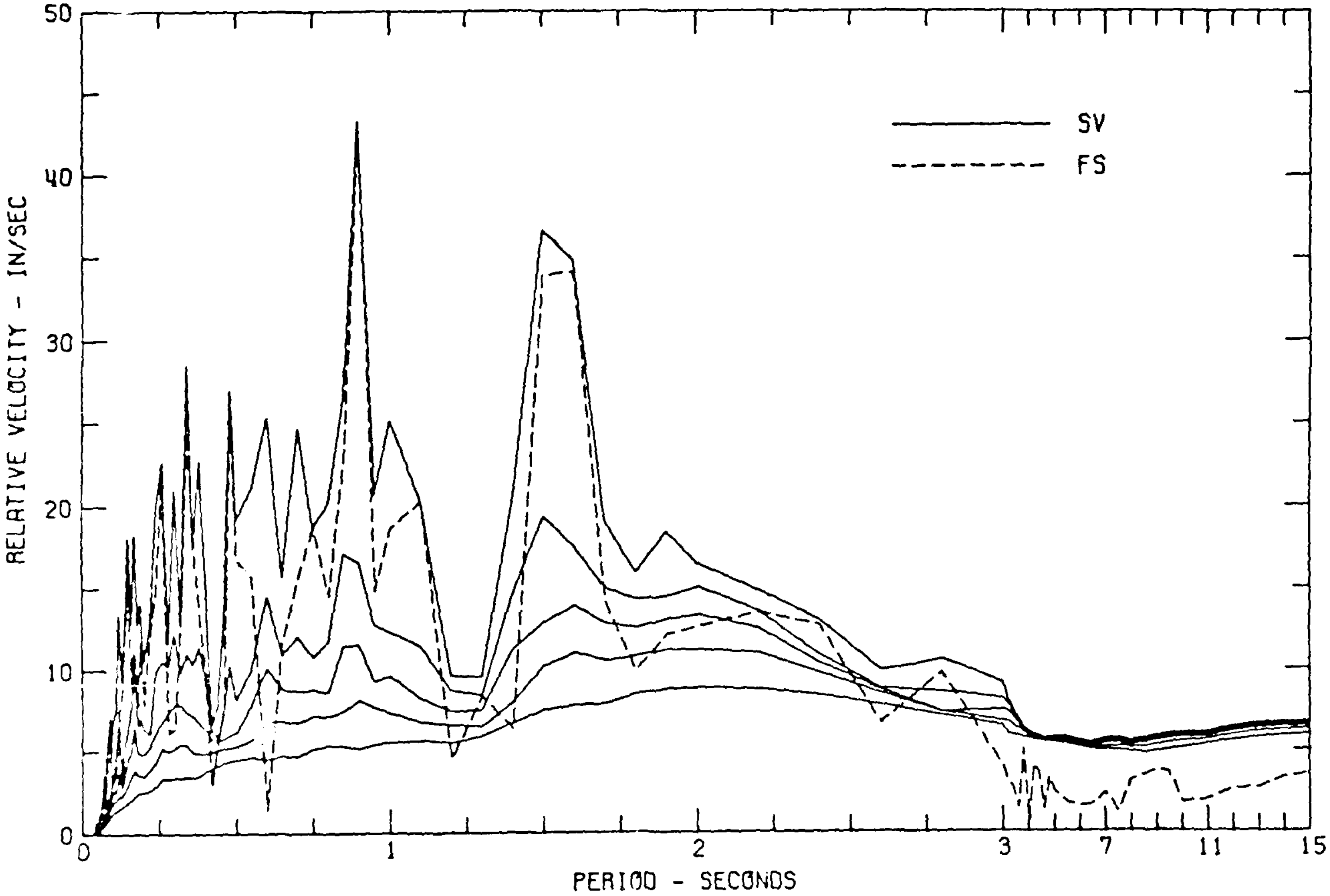
PUGET SOUND, WASHINGTON EARTHQUAKE   APR 29, 1965 - 0728 PST
IIB032 65.001.0   OLYMPIA, WASHINGTON HWY TEST LAB   COMP S86W
⊖ PEAK VALUES :   ACCEL = -194.3 CM/SEC/SEC   VELOCITY = 12.7 CM/SEC   DISPL = -3.8 CM
ACCELERATION
CM/SEC/SEC
-250
0
250
VELOCITY
CM/SEC
-20
0
20
DISPLACEMENT
CM
-4
0
4
0
10
20
30
40
50
60
70
80
TIME - SECONDS

RELATIVE VELOCITY RESPONSE SPECTRUM

PUGET SOUND, WASHINGTON EARTHQUAKE APR 29, 1965 - 0728 PST

IIIB032 65.001.0 OLYMPIA, WASHINGTON HWY TEST LAB COMP S86W

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL

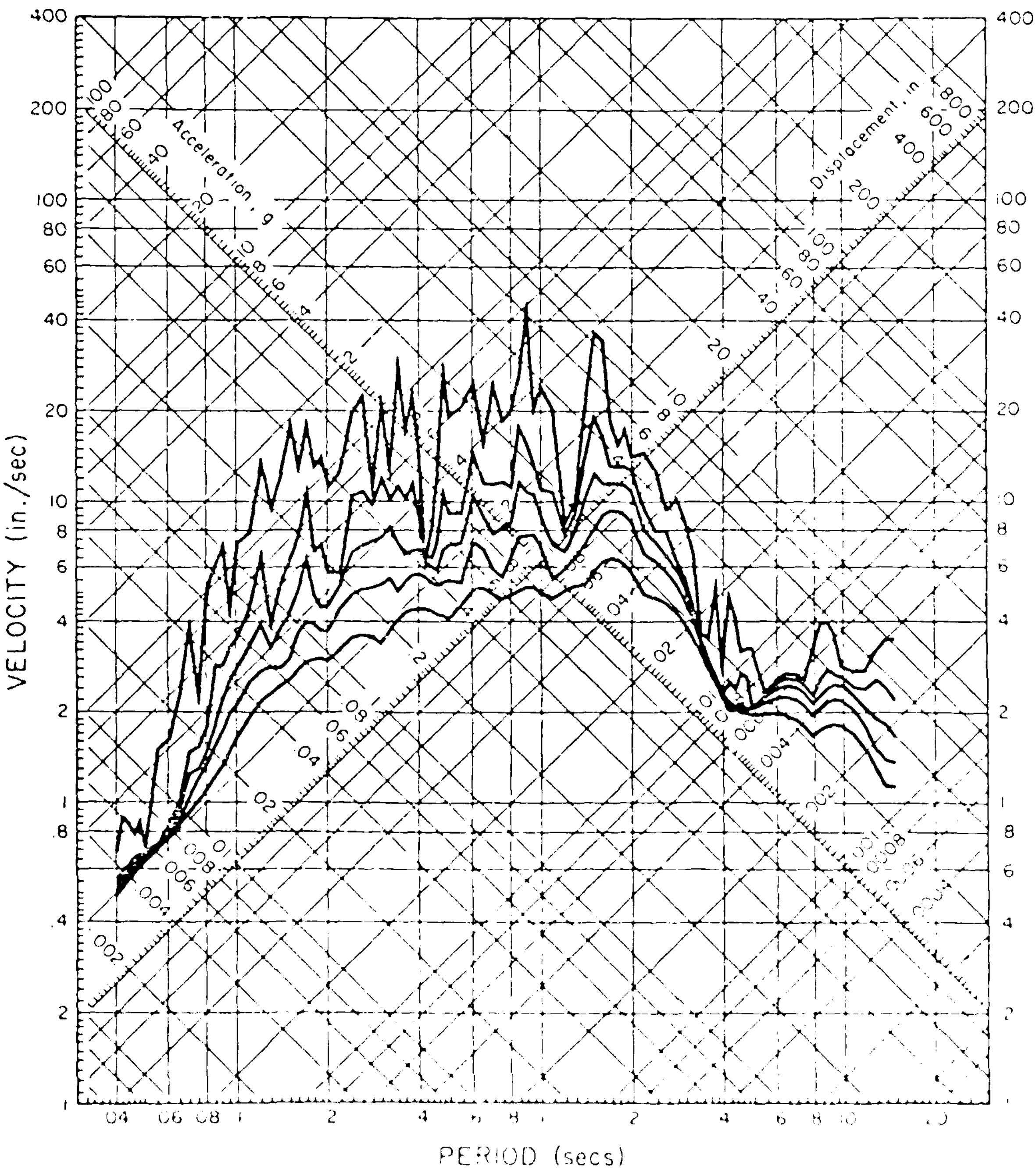


RESPONSE SPECTRUM

PUGET SOUND, WASHINGTON EARTHQUAKE APR 29, 1965 - 0728 PST

IIIB032 65.001.0 OLYMPIA, WASHINGTON HWY TEST LAB COMP S86W

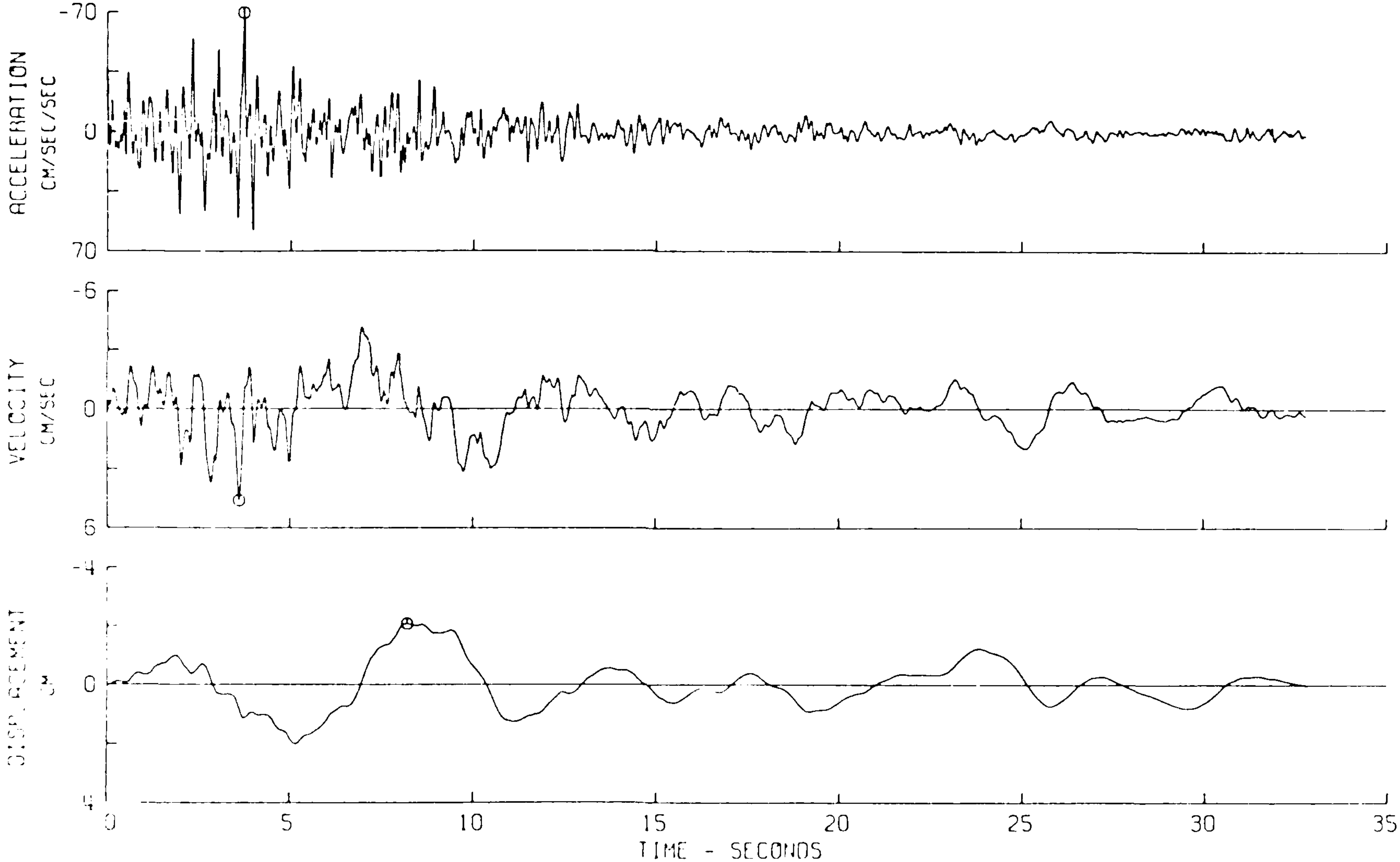
DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL



SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST

IIP223 71.153.0 PUDDINGSTONE RESERVOIR, SAN DIMAS, CAL. COMP N55E

⊙ PEAK VALUES : ACCEL = -69.7 CM/SEC/SEC VELOCITY = 4.6 CM/SEC DISPL = -2.1 CM

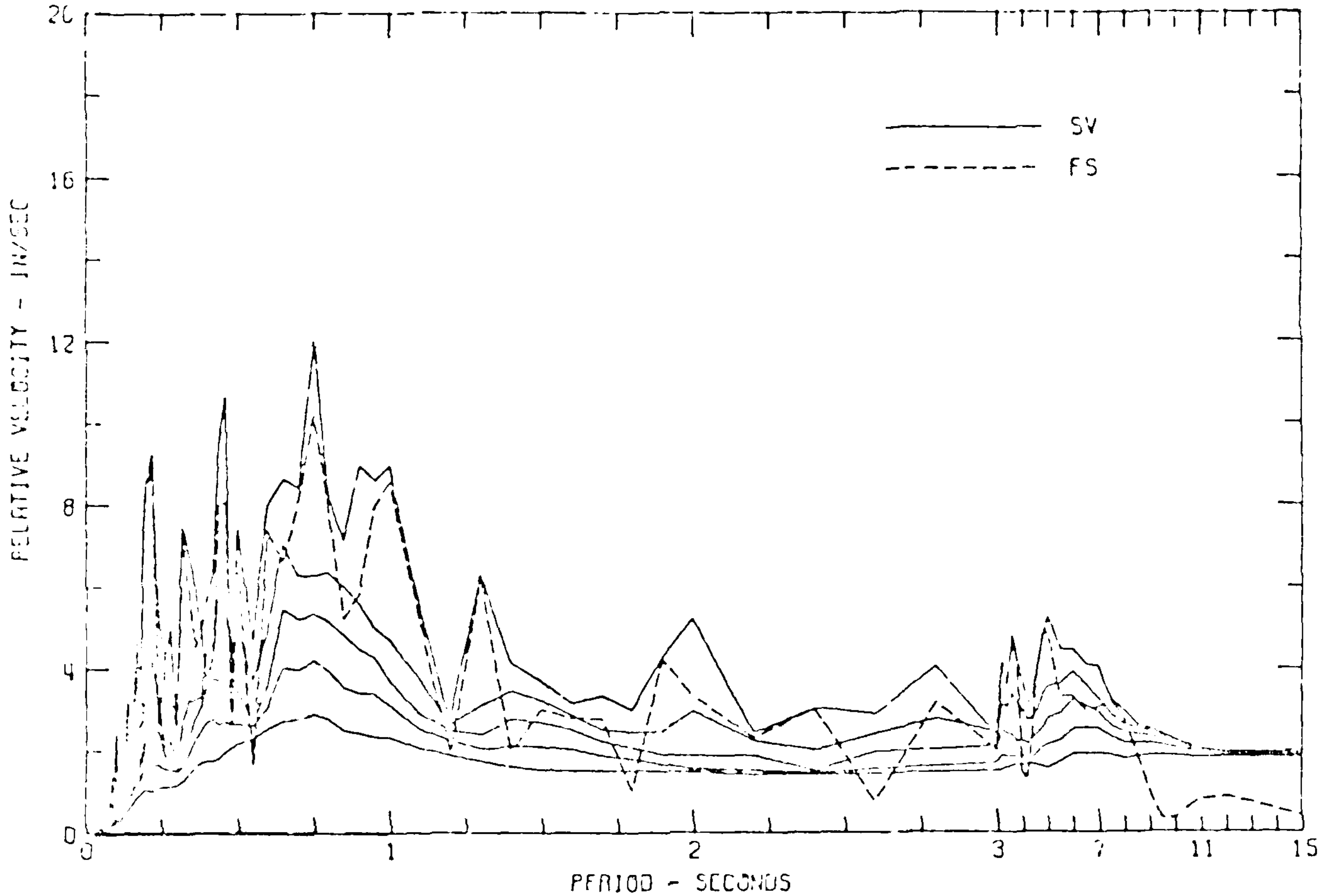


RELATIVE VELOCITY RESPONSE SPECTRUM

SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST

III P223 71.153.0 PUDDINGSTONE RESERVOIR, SAN DIMAS, CAL. COMP N55E

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL



RESPONSE SPECTRUM

SAN FERNANDO EARTHQUAKE FEB 9, 1971 - 0600 PST

III?223 71.1?3 0 PUDDINGSTONE RESERVOIR, SAN DIMAS, CAL. COMP N?E

DAMPING VALUES ARE 0, 2, 5, 10 AND 20 PERCENT OF CRITICAL